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CIVIL ENGINEERING.

On Metallic Constructions. By W. FAIRBAIRN, C. E., F. R. S.*

[Paper read at the Mechanics' Institution, Manchester.]

Continued from page 5.

The Effect of Shot on Iron Vessels.—Although at first sight alarming, they are, on more mature consideration, such as might be reasonably expected. A number of experiments were undertaken some years since at the arsenal, Woolwich, to determine the effect of shot upon the hull of an iron vessel, and also with the view of providing means for stopping the passage of water through a shot-hole near or below the water-line. The gun used in the experiment was a 32-pounder, at the distance of 30 yards from the targets, and was loaded with the full charge of 10 lbs. of powder, and a charge of 2 lbs. to produce the effect of distance, or a long shot. At these experiments I was present, and the results—some of which I may venture to mention—were exceedingly curious and interesting. The initial velocity of the ball, 6 inches diameter, with a full charge of 10 lbs. of powder, is about 1800 feet per second, and with 2 lbs. of powder about 1000 feet. In these experiments there were five or six targets, about 6 feet square, composed of different thicknesses of plates, and variously arranged so as to represent in effect as well as appearance a

* From the London Civil Engineer and Architect's Journal, May, 1852.

portion of the side of an iron ship. The engravings (fig. 1) represent a side view and section of the plates and fastenings of the targets, and (fig. 2) the effect produced by the shot as it passed through the plates, and in three or four experiments through a lining of india rubber and cork dust, which was specially introduced to absorb or receive the splinters.

Fig. 1.

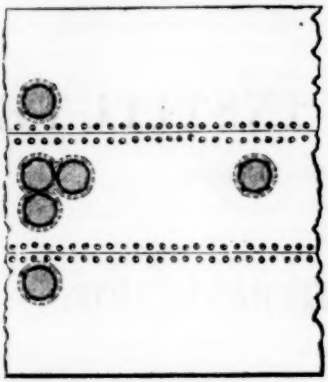
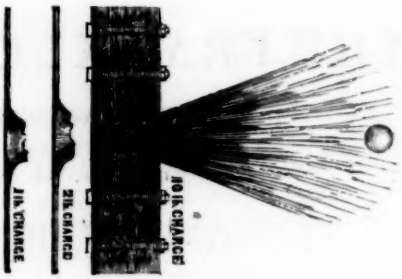


Fig. 2.



Whilst laying before you such information as I possess on the subject of iron ship-building, it is not my intention to trench upon the province of the marine architect as respects the lines, and other detail required in construction. This field is already occupied by men of superior talent, and the one that lays more immediately open before me is that which refers to the proportion of the parts, the distribution of the material, and the equalization of the powers of resistance to strain in all parts of the structure. These are considerations which, to a greater or less degree, affect almost every description of mechanical construction. If we study the laws of nature, we shall find in the endless varieties of construction in the animal and vegetable kingdoms no waste of material; that every animal and every plant is adapted to its purpose; its organization is perfect; every joint, muscle, and fibre is suited to the work it has to perform, and the utmost harmony, economy of material, and due proportion of the parts are the prominent features of the great teacher of all arts—Nature. With such examples before us, with such a wide and wonderful range of objects, why should we blunder and hesitate when we should analyze and investigate? There is no mechanism so intricate but what we find its compeer in nature, where we may find a rule for our guidance. We have, therefore, only to study the great Architect of the universe, and we need never be at a loss for examples, and, above all, close approximations to the laws which govern all constructions. As our present object is, however, to inquire into the laws which guide the experienced ship-builder in the prosecution of his art, it will be proper, in the first instance, to ascertain the nature and strength of the material he may choose to employ, in order to show the way it should be disposed to produce at a minimum cost the greatest possible effect. For these objects, I am fortunate in having before me a long series of experiments which I made for the same object more than ten years ago. They have elicited a great many facts,

of which the following is a short abstract, and which I trust may be equally beneficial in this as they have been in other constructions.

Resistance of Wrought Iron Plates to a Tensile Strain.—In these experiments, which were made on five different sorts of iron, the tensile strengths in tons per square inch are as follows:

Description of Iron.	In direction of fibre.	Across the fibre.
Yorkshire plates,	25·770	27·490
Yorkshire "	22·760	26·037
Derbyshire "	21·680	18·650
Shropshire "	22·826	20·000
Staffordshire,	19·563	21·010
Mean,	22·519	23·037

Or, as 22·5 : 23, equal to about $\frac{1}{23}$ in favor of those torn across the fibre. In following up the same investigation on timber, I found, according to Professor Barlow, of Woolwich, that the cohesive strength of different kinds of hard wood were—

Box,	20,000 lbs.	Beech,	11,500 lbs.
Ash,	17,000 "	Oak,	10,000 "
Teak,	15,000 "	Pear,	9,800 "
Fir,	12,000 "	Mahogany,	8,000 "

Assuming Mr. Barlow to be correct, and taking the main strength of iron plate, as given in the experiments, at 49,656 pounds to the square inch, or say 50,000 pounds, we have this comparison in pounds between wood and iron:

	Timber.	Iron.	Ratio.
Ash,	17,000	: 50,000	or as 1 : 2·94
Teak,	15,000	: 50,000	or as 1 : 3·33
Fir,	12,000	: 50,000	or as 1 : 4·16
Beech,	11,500	: 50,000	or as 1 : 4·34
Oak,	10,000	: 50,000	or as 1 : 5·00

Hence it appears that malleable iron plates are five times stronger than oak; or, in other words, their powers of resistance to a force applied to tear them asunder is as 5 to 1, making an iron plate ½-inch thick equal to an oak plank 2½ inches thick. In marine constructions, where the material is iron, our knowledge of its resisting powers would be incomplete, if we did not consider it in its union and all its bearings as regards its application to ship-building. Unlike timber, which has to be caulked between the joints, with a tendency to force them open, the iron ship is a solid mass of plates, which, if well riveted, will resist forces—such as the action of the seas—that no timber-built ship, however strong, would be able to withstand. The iron-built ship, when constructed with butt-joints, with interior covering plates, and smooth exterior surface, is superior as regards strength, buoyancy, and lightness, to any other vessel, of whatever material it may be constructed. In all these combinations it is, however, a desideratum to have the parts, the joinings, and the connexions as near as possible of equal strengths. This in practice cannot always be accomplished; but with due regard to a correct system of riveting and careful formation of the joints, a near approximation to uniform strength may be obtained. As a practical guide to these objects, I shall append a short summary of the experiment indicating the relative strengths of different forms of riveting, and in what they differ from the

strength of the plates, taking the whole as one continuous mass without joints. The results obtained from forty-seven experiments on double and single riveting are here recorded, the first column showing the breaking weight of the plates, the second the strength of single riveted joints, and the third that of double riveted joints, both of equal section to the plates, taken through the line of the rivets:

	lbs. per sq. inch.		lbs. per sq. inch.		lbs. per sq. inch.
	57,724	.	45,743	.	52,352
	61,579	.	36,606	.	48,821
	58,322	.	43,141	.	58,286
	50,983	.	43,515	.	54,594
	51,130	.	40,249	.	53,879
	49,281	.	44,715	.	53,879
	43,805	.	37,161	.	—
	47,062	.	—	.	—
Mean,	52,486	.	41,590	.	53,635

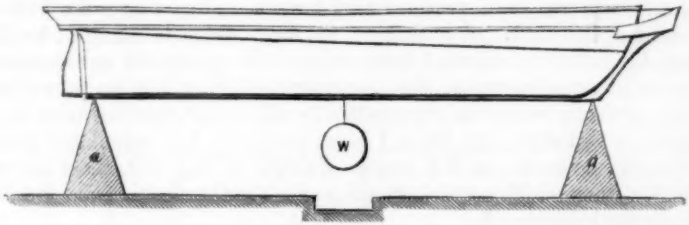
The relative strength will therefore be—for the plate, 1000; double riveted joint, 1021; single riveted joint, 791; which shows that the single riveted joints have lost one-fifth of the actual strength of the plates, whilst the double riveted joints have retained their resisting powers unimpaired. These are convincing proofs of the superior value of the double riveted joints; and in all cases where strength is required, this description of joint should never be omitted. In a previous analysis, the strengths were as 1000 : 933 and 731; but taking the mean, we have 1000 : 977 and 761 for the double and single riveted joints respectively. From these we must, however, deduct 30 per cent. for the loss of metal actually punched out for the reception of the rivets; and the absolute strength of the plates will then be to that of the riveted joints as the numbers 100, 68, and 46. In some cases, where the rivets are wider apart, the loss sustained is not so great; but in iron ships, boilers, and other vessels which require to be water-tight, and where the rivets are close to each other, the edges of the plates are weakened to that extent. Taking, however, into consideration the circumstances under which the results were obtained, as only two or three rivets came within the reach of experiment, and taking into account the additional strength which might be obtained by an increased number of rivets in combination, and the adhesion of the two surfaces of the plates in contact, we may reasonably assume the following proportions, which, after making every allowance, may be fairly considered as the relative value of wrought iron plates and their riveted joints. Taking the strength of plates at 100, we have for the double riveted joint 70, and for the single riveted joint 56; which proportions may safely be taken as the standard value of joints, such as are used in vessels required to be steam or water-tight, and exposed to a pressure varying from 10 lbs. to 100 lbs. on the square inch.

Having thus established correct data as respects the strength of materials, either singly or in combination, we shall have less difficulty in their application to the construction of vessels exposed to severe strains, such as boilers, bridges, or an iron ship; and notwithstanding the boasted declaration, that the "wooden walls of Old England" are our surest defences, we shall not, in my opinion, seriously injure, but greatly benefit our position by pinning our faith to the "iron walls of the sea-girt isle."

This, I am satisfied, will be the case if we persevere in the use of a material which must eventually supersede every other in the construction of vessels calculated to maintain the ascendency of the British marine.

Iron Ship-Building.—In the construction of iron ships three important considerations present themselves. First, strength and form; second, security; lastly, durability. To the first of these considerations, it will be necessary to ascertain for what purpose the vessel is to be used. Let us assume it to be one of the Atlantic, or other great ocean steamers, and we have a model both in form and tonnage, that would become equally formidable as a war steamer, or useful and commodious as a packet calculated to shorten the distance between the extreme points of a lengthened voyage. We must consider this important part of the question in all those varied forms and conditions to which vessels are subjected under strain, whether arising from a tempestuous sea, or from being stranded on a shore, under circumstances where they are not only seriously damaged, but where wooden vessels frequently go to pieces, and are entirely lost. In the former case, that of a tempest, such as a tornado under the tropics, where ships are not unfrequently much strained, we have in the iron ship, if properly constructed, greatly increased security; and provided we take the vessel in its best construction, and regard it simply as a huge hollow beam or girder, we shall then be able to apply with approximate truth the simple formula used in computing the strengths of the Britannia, and Conway, and other tubular bridges. Let us, for example, suppose a vessel of similar dimensions to the *Great Western*, (the first steamer that

Fig. 3.



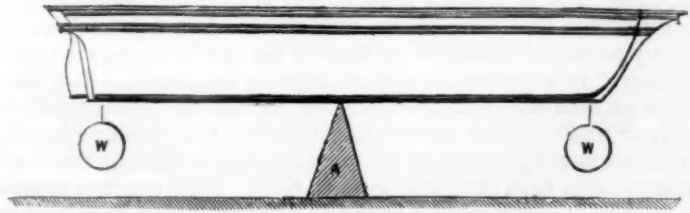


Fig. 4.

successfully crossed the Atlantic,) 212 feet long between perpendiculars, 35 feet beam, and 23 feet from the surface of the main deck to the bottom of the sheathing attached to the keel. Now, assuming a vessel of this magnitude, with its machinery and cargo, to weigh 3000 tons, including her own weight, and supposing, in the first instance, that she is suspended on two points, the bow and stern, at a distance of 210 feet, as shown in fig. 3, we should have to calculate from some formula yet to be ascer-

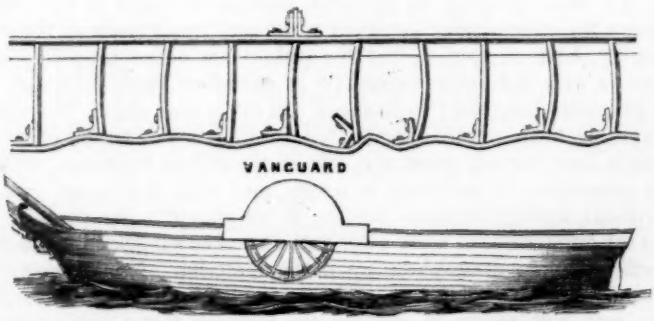
tained by experiment the correct sectional area of the plates, to prevent the tearing asunder of the bottom, and the quantity of material necessary to resist the crushing force along the line of the upper deck. These data have yet to be determined; but the iron ship-builder cannot be far wrong if he assumes the breaking weight in the middle to be equal to two-thirds of the united weight of ship and cargo. This, in the case before us, would give an ultimate power of resistance of 2000 tons in the middle, or 4000 tons equally distributed along the ship with her keel downwards. Let us now reverse the strains, and bring the vessel into a totally different position, having the same weight of cargo on board, and supported by a wave upon a single point in the middle, as shown in fig. 4. In this position, we find the strain reversed, and in place of the lower part of the hull of the ship being in a state of tension, the whole of the parts above the neutral axis are subjected to that strain; and that tension, as well as the compressive strain below, will be found to vary in degree as the ratio of the distances from the centre. In this supposed position, if we calculate the strengths—as I have been in the habit of doing, when the vessel is placed in trying circumstances, whether contending with the rolling seas of a hurricane, or the actual suspension of either portion when taking ground—we arrive at the conclusion that these calculations determine the strength, and that under any contingent circumstances we have given a wide margin, and fully determined the strength of the ship.

I am fully aware that many thousand vessels are now afloat that would not stand one-third of the tests I have taken as the minimum, but that is no reason why we should not endeavor to effect a more judicious distribution of material, and produce a maximum result, where the lives and fortunes of the public are at stake. On the question of security, we have fewer difficulties to contend with, and, so far as regards construction, I have endeavored to show, that in order to build a ship on principles as nearly perfectly secure as circumstances will admit, that she must be calculated to withstand the trials I have proposed her calculated to bear. Exclusive, however, of the simple strength of the hull, there are other considerations which require attention, such as the danger from fire, leakage, or total shipwreck.

In naval constructions we have three elements to contend with—fire, air, and water; and although we may effect in iron constructions extraordinary powers of resistance as respects the two latter, we are nevertheless subject to considerable risk as regards the former. It is true the hull of an iron ship will not burn, but the interior fittings, which are mostly of wood, if once ignited, might destroy everything on board, unless the necessary precautions are taken by iron bulkheads to cut off the communication from one division to another. From my own experience as a builder of iron vessels, I have found these bulkheads of inestimable value. They not only strengthen the ship transversely, but in case of injury to any part of the hull, any one of the divisions or compartments might be filled with water, and perhaps even the contents of that part burnt, without endangering the ship. These divisions, in fact, should be so arranged as to insure the vessel floating under circumstances of irreparable damage to any one of those parts of the ship. Again, in case of fire, under the lamentable position in which the *Amazon* was placed, it

might be advisable to have the extreme stem and stern bulkheads made double, with an air-space between them, and a valve in each to fill them with water up to the line of immersion, and thus prevent the division plates on that side clear of the fire from becoming red-hot, and igniting the timber fittings in that part which for the time might form a place of retreat. Much may be done in this way to mitigate, if not to avert, the calamitous and fatal consequences which ensue on those occasions. Bulkheads of this description, coming up to the underside of the upper deck, might obstruct to some extent the communication between decks from one compartment to another; but I believe a sufficient freedom of access from one part to another might easily be effected by well constructed iron doors, easily closed in case of accident, when they would become effectual barriers to the spread of destruction. In carrying these objects into effect, we must recur to the use of iron in every case where packet ships and steamers are employed. They apply with the same force to her Majesty's Navy, and particularly to steam frigates, and ships of war with auxiliary power. It is true, that the experiments already referred to of the dangerous effects of shot on the iron hull are alarming, but the amount of risk and destruction is always one of degree. I doubt whether the effects of shot on wooden vessels are less terrible, and undoubtedly the security gained by bulkheads and such contrivances are more than the claim to security. Besides, we are not yet satisfied that these effects are so dangerous as has been represented. On the contrary, I am of opinion that they have been greatly exaggerated, and that increased experience will ultimately show that the iron ship, under all circumstances, affords greater security, whether for war or commerce, than any other construction. As a proof of the advantages peculiar to iron as a material for shipbuilding, and the greatly increased security which it offers in comparison

Fig. 5.



with wood, the engraving, fig. 5, shows the condition of the steamer *Vanguard*, which ran foul of a reef of rocks on the west coast of Ireland, and continued beating upon them for several days with comparatively little injury. Another instance is that of the *Great Britain*, which stood the action of heavy seas beating her upon the sands and rocks of Dundrum Bay for the whole winter, and that without any serious damage to the hull.

Durability of Iron.—On this part of the subject, there is considerable

difference of opinion, but a very cursory view of this important question will at once show the great superiority which exists on the side of iron against timber. Although I proposed at starting to treat of metallic constructions alone, I have found it useful to add a few data, showing the strengths of different timbers which are used in combination with the metallic frameworks; and have therefore given the comparative strength of iron and the best English oak, in which it is proved that iron as a material is five times stronger than oak. This is, however, not the question which enters into the subject of durability, as the jointing of the one is incomparably superior to that of the other. In the building of ships of the line, or large merchant vessels, the keel, beams, and timbers are generally of oak or teak, made of three pieces, ingeniously contrived, and united by scarphs to each other to insure strength. The ribs or frames, which are solid and close to each other, are scarphed and jointed in the same way, and the outer sheathing, which is copper-fastened, is also attached with great care, and by crossing the vertical joints of the frames great strength is obtained. The connexion of the deck-beams to the frames by strong iron knees is another source of strength; but with all the care and ingenuity and skill bestowed upon this construction, it is far from perfect in point of strength, as the vessel, when pitching and rolling in a heavy sea, produces motion at every joint, and it not unfrequently happens that the seams open and close to an extent sufficiently obvious as to the nature of the structure and defective union of the parts. Now, in the iron ship we may venture to state, that when all the parts are soundly riveted together, there are no joints. The whole may be considered as continuous, consequently there can be no yielding, except from the elasticity of the mass to the action of the sea. The plates are the same as the planking or sheathing of timber-built ships, and these plates are riveted to strong iron ribs, varying from 12 to 15 inches asunder, and answering the same purpose as the solid framing of a teak or oak vessel. As respects the comparative merits of wood and iron vessels on the score of durability, I am of opinion that the public has entertained very erroneous views with reference especially to oxidation, which for the last twenty years has been the "rock ahead" of every iron ship. The extent of this evil has been greatly exaggerated, for there are instances of several iron vessels built twenty years ago, which are still in existence, with no sensible appearance of corrosion or decay, and what is of equal importance, without having required repairs, if we except a few coats of oil-paint, or the application of some other anti-corrosive substance, to neutralize the effects of the atmosphere upon the material. Nature, however, comes to our assistance in this as in almost every other attempt in the constructive arts, and seems to confirm the proverb that a "bright sword never rusts;" for it is with iron ships as with iron rails when in constant use, there is little if any appearance of oxidation. Taking, therefore, the whole circumstances into consideration, we may reasonably conclude that much has yet to be done in this department of the useful arts, and make no doubt that the iron ship of British origin will yet ride triumphant on every sea, as the harbinger of peace, the supporter of commerce, and the great and only security of our national defence.

If, in my attempt to elucidate a subject of such vast extent, and of such

national importance, I have been successful in conveying to your minds in plain words that knowledge which it is important we all should know, I have attained the main object of my appearance in this place.

At the conclusion of the paper, a vote of thanks to Mr. Fairbairn was proposed and seconded, which was very warmly accorded.

Railway Accidents; their Cause and Means of Prevention; detailing particularly the various Contrivances which are in use, and have been proposed; with the Regulations of some of the principal Lines. By Captain M. Huish.*

The author first considered those points connected with the road, and the machinery employed upon it, from which loss of life and injury to person and property most generally arose. With regard to the road or permanent way, from which fewer accidents occurred than from any other cause, its complete effectiveness was the basis of all safety in railway traveling; and for keeping it up, constant vigilance was necessary, especially when any great and sudden change of weather took place, as then the weak points were sure to show themselves. It was a very rare occurrence for trains to run off the line; and when they did so, it was more generally due to obstructions designedly placed on the line, than to any neglect of the superintendents or the plate-layers. It was little suspected how frequent, how ingenious, and how varied the attempts had become to inflict a fearful injury by these means; and though, providentially, but comparatively trifling damage had resulted from such causes, yet it was lamentable to find that in addition to all ordinary risks, so diabolical a mode of wreaking a petty vengeance, or gratifying a mischievous disposition, had to be guarded against. Of late, the punishment for such offences had been made more severe; and it was to be hoped that this would have the effect of lessening their number. Owing to the rapid developement of the traffic, and particularly of the heavy goods traffic, on the main arterial lines of the country, increased siding accommodation had become necessary; in the case of the London and North-Western Railway alone, upwards of fifty-three miles had been laid down within the last few years, although, by multiplying points and crossings, this had, *pro tanto*, increased the liability to accident; for it might be received as an axiom, that any thing which broke the continuity of a rail tended to develope danger. As, however, there were no means of avoiding these frequent "turns out," judicious regulations combined with effective signals must be relied on, and now that facing points were reduced in number, the liability to danger had been diminished. The use of self-acting switches was attended with evils of no trifling magnitude, and many accidents had occurred from reliance on them; indeed, as a general rule, machinery to supersede personal inspection and manipulation was fraught with danger.

With respect to the rolling stock, it appeared from a return of one thousand cases of engine failures and defects within two years on the London and North-Western Railway, that burst and leaky tubes nearly

* From the London Civil Engineer and Architect's Journal, May, 1852.

doubled any other class of failure; and that these, with broken springs and broken valves, amounted to one-third of the whole number; and though they caused no direct danger to the public, yet as producing a temporary or permanent inability of the engine to carry on its train, they might be the remote cause of collision. The passenger carriage, from its perfect manufacture, presented almost complete immunity from accident, for during the last four years, out of the large stock of the London and North-Western Railway, only six wheels had failed; and though at first some annoyance and alarm had been experienced from heated axles, yet by the recent introduction of the patent axle-box, it had been much reduced. The same praise could not be bestowed on the merchandise wagon, as in no portion of the system had so little improvement been made; the fracture of axles was frequent, the mode of coupling very defective, and the want of spring buffers, or even of buffers of the same height and width, rendered the destruction of property enormous. No loss of life from fire, either from heated coke or spontaneous combustion, had occurred to a passenger train, but there had been some narrow escapes.

These and other circumstances had led many persons to suggest various contrivances for communicating between the passengers, the guard, and the engine-driver, almost all of which were identical in principle, consisting of a connecting wire or rope. This plan had been tried and failed. A more feasible and favorite one was that recommended by the Railway Commissioners, which was to continue the foot-boards, so as to form a narrow platform from end to end of the train; but a committee of railway officials had subsequently expressed their unanimous condemnation of the measure. The plan now adopted on the London and North-Western Railway was, for the guard's van, at the end of the train, to project about a foot beyond the other carriages, so that the guard looking through a window in this projection, might notice the waving of a hand or a handkerchief; this was, of course, useless at night.

All these causes, however, did not produce a tithe of the accidents which resulted from a want of attention to signals and a neglect of regulations, which of all sources of danger were the most prolific. Railway stationary signals had been greatly improved of late years, and the introduction of the lofty semaphores and the auxiliary signals really left little to be desired. Besides these, there were the hand signals, to be used by the guard in cases of stoppages between stations, and the detonating signals, to prevent collisions during a fog, which latter supplied the deficiency that had been experienced, and they were found to answer exceedingly well.

The electric telegraph had greatly facilitated working under variable circumstances, and so beneficial had its effects been, that, during the year 1851, out of 7,900,000 passengers, or nearly one-third of the population of England, who had traveled over the London and North-Western Railway, only *one* individual had met with his death, (from which casualty the author also suffered,) and this was the effect of the gravest disobedience of orders. In the six months during which the Exhibition was open, 775,000 persons were conveyed by excursion trains alone, in 24,000 extra carriages, centering in a single focus, arriving at irregular hours and

in almost unlimited numbers, from more than thirty railways, without the most trifling casualty, or even interruption to the ordinary extensive business of that line.

The author thought undue importance had been attached to the question of irregularity in the times of the trains, as an essential element of safety, for with perfect signals and a well disciplined staff, no amount of irregularity should lead to danger; but, on the contrary, it should, to a certain extent, by its very uncertainty, induce increased vigilance, and therefore greater safety. Accidents very rarely happened from foreseen circumstances, but generally from a simultaneous conjunction of several causes, and each of these was provided for as it arose. The statistics of railways, and the periodical publication of the Government returns, drew public attention very pointedly to the aggregate of accidents; but it was believed that if due regard was had to comparative results, if the accidents to steamers, or in mines, to omnibus passengers, or even to pedestrians, were as carefully recorded, that then, whether as regarded the ease and celerity of transit, or the facility of conveying numbers, the railway system, even in its present state, would be found to be incomparably safer than any other system in the previous or present history of locomotion.—*Proc. Inst. Civ. Eng., April* 27, 1852.

AMERICAN PATENTS.

List of American Patents which issued from June 8th to June 29th, 1852, (*inclusive,*) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

16. For an *Improvement in the Construction of Retorts for Chemical Furnaces;* John Akrill, Williamsburg, New York, June 8.

Claim.—"I disclaim all processes to which these retorts are applicable, and all chemical compounds and mode of working the same, which are herein described; and I disclaim all the apparatus shown herein, except as follows:

"I claim the retorts, H, formed by the arch, 7, and bed, 6, with the sides, 5, 5, and perforated with the cross flues, 10, 12, or 13, below the bed and above the arch of each retort; said retorts being formed and operating as herein set forth, and being used for any purpose for which they may be available."

17. For *Improvements in the Manufacture of Plate and Window Glass;* Terence Clark, Pittsburg, Pennsylvania, June 8.

"My invention consists, 1st, in a new and improved combination of machinery for rolling plate glass; and, 2d, for a new and improved construction of an oven for fire-polishing the plates or sheets of glass."

Claim.—"Having thus described my improved mode of making window or plate glass by machinery, what I claim as my invention is, 1st, The use of hollow chilled iron rollers, in the manufacture of window and plate glass, in connexion with the mode of heating them with charcoal or other combustible placed inside.

"2d, The combination of the grooves with the strips and guides and the set screws, for the purpose of regulating the width and thickness of the sheet of glass.

"3d, The use of trucks, for carrying off the sheets of glass as they pass from the rollers as aforesaid."

"4th, The combination and arrangement herein before described, of the gates, flues, and furnace, in the construction of the polishing oven."

18. For an *Improvement in Processes for Preparing Oakum;* John A. and George Cormack, City of New York, June 8.

"The nature of our invention consists in the treatment of junk, or tarred ropes and such like materials, in an aqueous solution of sulphuric or muriatic acid, which solution or solutions imparts to the oakum manufactured from the junk new and useful qualities, not obtained by any other process heretofore known or practised."

Claim.—"We claim the treatment of junk, by steeping or rinsing it in acidulous liquor as described, for the purpose herein set forth."

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19. For an *Improvement in Cow Catchers;* Cook Darling, Utica, New York, June 8.

Claim.—"What I claim as my invention is, the wheel and the guard, connected and arranged substantially as herein described, and for the purposes described."

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20. For *Improvements in Cop Spinning Frames;* George H. Dodge, Attleborough, Massachusetts, June 8.

Claim.—"What I claim is, the toothed quadrant, y, the pinion, x, and its shaft, w, in combination with the two scroll cams, t, v, their chain, u, tubular shaft, f, and the clutch contrivance made with the spring click, g, and one single detent or opening, d, the whole being applied to the scroll shaft, L, and spur gear, M, and made to operate substantially in the manner and for the purpose as herein before stated.

"I also claim the ratchet wheel, w^2, the arm, b^3, and retaining pawl or click, c^3, or any mechanical equivalent therefor, in combination with the balance wheel apparatus, (viz: the arm, x^2, the fly wheel, y^2, its shaft and pinion, a^3,) and the spur gear, s^2, having a positive motion as described, the whole being for the purpose as specified.

"And in combination with the scroll shaft and its mechanism, for effecting the upward and downward movement of the ring rail, I claim the mechanism for effecting the change of the downward to the upward motion of the said rail, in an easy manner, and so as to prevent injurious strain, when the spring click, g, strikes into the recess, d, of the clutch flanch, c, the said mechanism consisting of the arm, f^3, roll, g^3, spring, h^3, tube, i^3, rod, k^3, cam, l^3, curved lever, m^3, and spring, o^3, or their mechanical equivalents, combined and operating together substantially as herein before described.

"I also claim the improvement of so applying or combining the thread guide G, or the guide bar or rail, u^3, to or with the ring rail and the frame, that the said guide or guide bar shall be movable, or made to move upwards and downwards, while the ring rail so moves, and this with a movement either equal to or in accordance with that of the ring rail, or a variable, as circumstances may require, the same being for the purpose as specified.

"And in combination with the scroll, z, its chain and connexions with the ring rail, I claim a compensature mechanism or apparatus, for regulating the action of the copping rail or rails on the said scroll, according to the leverage, or in other words, for providing a compensation for the difference of leverage produced by the swell, as described, the mechanism employed by me, and the combination of which I also claim, consisting of the two cams, d^4, e^4, the pullies, i^4, k^4, the chains, l^4, m^4, n^4, and weight, o^4, as applied together and to the frame, and operating substantially as specified.

"And I claim the bent arm and its projection, k, or other equivalent contrivance, in combination with the driving belt, shifting lever, or contrivance; the same being for the purpose as herein before set forth.

"And I also claim my improvement in the construction of the thread guide, G, the same consisting in making the opening of it straight on its rear side, substantially as seen at q^4, r^4; the same being for the purpose as herein before explained.

"And I also claim my improved or new combination of mechanism, by which a sudden or very quick rise of the copping rail is effected, in order to finish each upward movement, and this so as to wind as little yarn as possible at the nose or upper end of each conic layer composing the cop; the said combination consisting of the arm, l^2, upon the scroll shaft, L, the levers, k^2, m^2, the arm, e^1, and the rollers, b^1, p^2, as applied and operated together essentially as herein before specified."

21. For a *Smoke and Spark Deflector;* Albert Eames, Springfield, Massachusetts, June 8.

Claim.—"I do not wish to limit myself to the special form or position of the deflecting tubes, so long as the same end is attained by analogous means. What I claim as my invention is, the method of directing the discharge of smoke and sparks, or either, from the chimney of a locomotive, by combining therewith deflectors, substantially such as herein described, the apertures thereof being governed by a valve or shutter, substantially as specified."

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22. For an *Improvement in Machinery for Making Spoons, Forks, &c.;* Alfred Krupp, Essen, Prussia, Assignor to Thomas Prosser, City of New York, June 8, 1852; patented in England, August 26, 1846.

Claim.—"What I claim is, the employment, for trimming the edges and giving the ornaments to the blanks, of a pair of rollers, each of which is furnished with a cutting edge and a device engraved within the same, and a space outside of said cutters, for the reception of the waste; said rollers being so worked and applied to each other, that the cutting edges of the one comes in contact with and cuts against the cutting edges of the other.

"I do not claim simply a movable die; but what I do claim is, a movable die, located within the pattern dies, so that spoons or forks, having various crests, names, or initials thereon, may be made by the same contour or device and edge pattern."

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23. For an *Improved Process for Making Axes;* John Orelup, Assignor to Isaiah Blood, Augustus J. Goffe, and George R. Thomas, Ballston Spa, New York, June 8.

Claim.—"I claim the method of manufacturing axe poles by a process, of which the following are its successive steps, in combination with other, as they are applied to the metal bar, when heated and prepared for manufacture, viz:

"1st, Spreading the iron bar at four points on its edges, by strokes of a peculiar tool made for the purpose.

"2d, Forming half eyes across the bar at spaces equidistant from its centre, by strokes of a narrow and round edged hammer.

"3d, Finishing the half eyes, and making them equal and similar, on a swaging tool.

"4th, Cutting the bar partly through across its centre, and doubling together the halves of the bar, so that the half eyes shall unite in correspondence with each other, and form the eye of the axe, completing the whole ready for welding the two halves of the pole together, substantially as the process is set forth in the above specification."

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24. For an *Improvement in Reflector Lamps;* James H. Pease, Reading, Pennsylvania, June 8.

Claim.—"What I claim as my invention is, a reflector lamp, constructed substantially as herein set forth, with a case containing a cooling liquid, for the protection of the reflector from injury, as herein described."

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25. For an *Improvement in Wheel Cultivators;* Frederick P. Root, Sweden, New York, June 8.

Claim.—"Having explained my improvements in wheeled cultivators, I will here state that I am fully aware that there are other modes of raising and lowering the frame containing the teeth of cultivators in use, particularly that patented to David B. Rogers, January 16th, 1849, which consists mainly of a combination of a crank axle-tree, extending across the centre of the frame, on the ends of cranks whereof are mounted the sustaining wheels; while I acknowledge the similarity of the lifting action of the cranks of the axle-tree, to that of the pivoted segment levers used by me, and which I disclaim; yet I am not aware that Mr. Rogers is entitled to claim all means for effecting the same result, and I conceive that my improvements differ in material points from his, and which form the subject of my claims as follows:

"1st, Mounting the carriage wheels upon axles, only when said axles are made to project from pivoted segment shaped levers at each side of the frame, in the manner and for the purposes specified."

26. For *Improvements in Seed Planters;* James P. Ross, Lewisburg, Pennsylvania, June 8.

"My improvement consists in the seeding apparatus, by which the seed is conveyed in measured quantities from the hopper to the tubes, which conduct it into the teeth, and also in the mode of hoisting the teeth, by which a much larger range of motion can be given to the teeth than is practicable where levers are used; also, the mode of throwing the seeding apparatus into and out of gear; and, lastly, the measuring index for measuring the quantity of land seeded."

Claim.—"Having thus fully described my improvements, what I claim therein as new is, 1st, The seeding apparatus, constructed substantially in the manner and for the purposes set forth, consisting of the cup and receivers, the plate, gate, and their attachments.

"I also claim the mode of putting the cups into motion and stopping them, by shifting the pitman, as described, on to or from the eccentric, by the windlass, in the manner set forth.

"I also claim raising and holding the teeth by the employment of the apparatus for turning and holding the windlass, consisting of a crank and bevel wheels, as described, so that one man can easily raise the teeth to any desired height, and to a much greater range, than can be done by levers, or similar devices, and attach it in that position, by the revolving clutch, which meets, when at the proper height, with the crank which it fastens."

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27. For an *Improvement in Harvesters;* George H. Rugg, South Ottawa, Illinois, June 8.

"The nature of my invention consists in the peculiar arrangement of the fingers which set over the sickle, and by which the sickle, with the aid of the rivets which will be hereinafter described, is prevented from being clogged."

Claim.—"Having thus described the nature and operation of my invention, what I claim as new is, the curved fingers, in combination with the rivets, projections below the sickle, by which means the sickle is prevented from being clogged or bound, substantially as described."

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28. For an *Improvement in Seed Planters;* Benjamin D. Sanders, Holliday's Cove, Virginia, June 8.

"The nature of my invention consists in operating a shove rod, and thus distributing the seed, by means of a cam placed on the axle of the wheels, a greater or less vibration may be given the shove rod, by properly adjusting the cam, which is divided vertically into two parts, and having a greater or less distance between the two parts, the length of the vibration of the shove rod may be regulated, so that the grain may be distributed faster or slower, as desired."

Claim.—"Having thus described the nature and operation of my invention, what I claim as new is, the construction of the serpentine driving cam, E, the cam being formed of two parts, *f g*, and placed on the axle, F, the part, *f*, of the cam being fixed firmly to the axle, and the part, *g*, moving freely thereon, and secured at the desired point to the axle, by the set screw, *h*, each part of the cam being formed of a collar, having a zigzag or serpentine thread or projection upon it, the friction roller or bulb, G, at the lower end of the lever, D, fitting between the threads or projections which act against it, as the cam revolves, and give a reciprocating motion to the shove rod, C, substantially as described."

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29. For an *Improvement in Hay Rakes;* Zenas Sanders, West Windsor, Vermont, June 8.

"The nature of my invention consists in attaching the teeth of the rake to the axle-tree or head of the rake, and in attaching and adjusting the thills to the same by hinges, in order to raise the teeth from the ground, and clear the same, by rolling and turning the axle-tree or head; and also in attaching and adjusting the whipple-tree to the same."

Claim.—"What I claim as my invention is, the construction of the axle and rake head, with hinges connecting it with the platform, in combination with the draft strap, to raise and depress the rake teeth, in the manner and for the purpose set forth."

30. For an *Improvement in the Construction of Soap Boilers;* John R. St. John, City of New York, June 8, 1852; patented in England, June 6, 1851.

Claim.—"Having thus described the construction and operation of my apparatus for heating, boiling, and mixing by steam, I desire it to be understood that I do not claim to be the original inventor of the application of steam to heating, boiling, and mixing; but what I do claim as my invention is, the combination of the steam jacket, tubes, and agitating rods, for transmitting and equally diffusing heat through soaps and other similar substances, where it is difficult to keep up an uniform heat throughout the mass, substantially in the manner set forth and shown."

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31. For an *Improvement in Rat Traps;* John I. Vedder, Schenectady, New York, June 8.

"The nature of my invention consists in a novel and simple arrangement of mechanism, which is placed or arranged on the top of the trap, by means of which the rat, after he has been caught, is made, through his own weight, to reset the trap for his fellow rat, and after resetting the trap, he is precipitated into a tub or barrel filled with water, and drowned."

Claim.—"What I claim as my invention is, the employment of the pulley, cords, and inclined tilting passage; the whole being arranged as described, and operating in combination with the tooth, having a tilting door arranged on the top of the same, and a guard placed around the door, in the manner and for the purpose specified."

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32. For an *Improvement in Grease Cocks;* Robert M. Wade, Wadesville, Virginia, June 8.

Claim.—"Having described my invention, what I claim therein as new is, the inclined discharge passage, of varying area, constructed, arranged, and operating, with respect to and in combination with the hollow cylinder, and its aperture, in the manner and for the purpose herein set forth."

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33. For an *Improvement in Fastenings for Garments;* Elbridge G. Belknap, Spring Garden, Pennsylvania, June 15.

Claim.—"I claim the combination of the catch-plate with the plates above and below it, as shown and described. I claim the perforated bar for preventing the instrument from turning, the whole being arranged and acting substantially as set forth."

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34. For *Improved Valves, or Gates, for Oblique Float Paddle Wheels;* Jacob C. Carncross, Philadelphia, Pennsylvania, June 15.

"The nature of this invention consists in placing at the edges next each other, of the obliquely arranged paddles of the wheel, a series of radial gates, turning on journals, and having right angled wings at their axis, for keeping them closed when they pass through the water, to prevent the water being moved laterly by the oblique paddles."

Claim.—"Having thus fully described my invention, what I claim as new is, the series of radial winged and pivoted gates, for preventing the water acted on by the paddles being moved laterally, as they move through the water, and opening to deliver the water freely, at the proper time, arranged and operating substantially as described."

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35. For an *Improvement in Mills for Crushing Quartz;* John W. Cochran, City of New York, June 15.

Claim.—"Having described the manner in which I construct my machines, what I claim as my invention is, giving motion to the balls between the two plates or disks, in the manner and for the purpose substantially as above specified."

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36. For an *Improvement in Piano Fortes;* William Compton, City of New York, June 15.

Claim.—"I do not claim as new, metallic frames, nor bridges, neither the upbearing

of the strings, nor bringing the strings to an equal length, other than in connexion with my arrangement; what I claim is, making the perforated bridge for the upbearing of the strings, a part of the solid arched frame or plate, as described."

37. For the *Manufacture of Granular Fuel from Brushwood and Twigs;* Reuben Daniels, Woodstock, Vermont, June 15.

Claim.—"I claim the granular fuel produced from brushwood and twigs, by cutting the same into lengths about equal to its average diameter, as herein described, as a new manufacture."

38. For an *Improvement in Cast Iron Car Wheels;* Peter Dorsch, Schenectady, New York, June 15.

Claim.—"I claim the double reversed corrugations, connecting the rim and hub, formed and acting as described and shown, and the combinations of these corrugated parts with the annular cylinder, between them and the hub, as described and shown."

39. For an *Improvement in Machines for Making Cigars;* William Dawson, Huntington, Connecticut, June 15.

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, the manner herein described of making cigars, viz: by combining with the cutters and followers which cut off and feed in the requisite quantity of tobacco for each cigar, the rollers for rolling up the fillers and putting on the wrappers, said rollers having the requisite arrangement of parts, so as to open to receive the material, and close to form the cigar, and again open to deliver the finished article, in the manner substantially as herein described.

"I also claim the making of the roller which feeds in the wrapper, of less diameter than the rollers which form the filler, so that the filler may move at an increased velocity over that of the wrapper, for the purpose of more evenly spreading out the wrapper, and winding it more tightly upon said fillers, substantially as herein described."

40. For a *Machine for Polishing Daguerreotype Plates;* Townsend Duryea, Williamsburg, New York, June 15.

Claim.—"I do not claim the platform, nor frame, neither do I claim the reciprocating bed, separately; but what I claim as new is, the horizontal reciprocating bed, operated in the manner as described, or in any other equivalent way, in combination with the frame, for the purpose as herein specified."

41. For an *Improvement in Alarm Locks;* Charles Fleischel, City of New York, June 15.

Claim.—"Having thus described the nature of my inventions, their construction and operation, that which I claim as new is, the combination of the slide and button, constructed for the purpose of making and breaking the connexion of the bell and hammer with the bolt, catch, latch, or fastening of the lock, substantially in the manner I have described.

"I also claim the combination of the lever with the bolt and catch, or latch of the lock, by means of which, the movement of the catch is prevented, when the bolt is projected, and the catch is drawn by the same key which has drawn the bolt, constructed and operating substantially in the manner I have described."

42. For an *Improvement in Preparing Cotton Yarn for the Manufacture of Duck, and other Coarse Fabrics;* Horatio N. Gambrill, Baltimore, Maryland, June 15.

"The nature of my invention consists in passing the yarns, either single or in warps, and which are to be used without sizing, between, over and around rollers or heated pipes, which supply moisture, heat, and friction, for the purpose of softening, removing the elasticity of the threads, and condensing it, so as not to be chafed in the weaving, and so as to give the cloth the requisite body and pliability, to be more readily sown, and prevent its shrinking or stretching afterwards."

Claim.—"Having thus fully described my invention, what I claim therein as new is, the process herein described, of preparing yarns for coarse cotton goods, but more particularly for cotton duck, by passing them through between moistening rollers, or otherwise wetting them, and then passing them over or around grooved or plain heated steam pipes, or rollers, for removing their elasticity, smoothing and condensing them, whilst in a state of proper tension, substantially as herein described."

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43. For an *Improvement in Organs;* Albert and George Gemunder, Springfield, Massachusetts, June 15.

Claim.—"What we claim as our invention is, the use of a separate air chamber for supplying wind to all the pipes of a single stop as herein described, and as opposed to the old method of having a single air chamber supply all pipes of the same note or letter in the different stops; and, finally, we claim the combination of air chambers, such as are herein described, with valves communicating with the several pipes, and operated by mechanical agencies, such as are shown in the foregoing description, explanations, and the accompanying drawings, substantially as herein described."

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44. For an *Improvement in Carriage Axles;* Kingston Goddard, Philadelphia, Pennsylvania, June 15.

"The nature of my invention consists in making the box in two or more parts, with a recess to receive and embrace a collar on the journal part of the axle, or what is essentially the same, with a projecting fillet to fit into a recess in the journal part of the axle, when this is combined with the mode of securing and holding the said box on the axle, by making its periphery conical, to fit and be drawn into the hub, or into a pipe box fitted to the hub, so that by simply securing the said box within the hub or pipe box, the axle is at the same time secured within the box."

Claim.—"What I claim as my invention is, making the box in two or more parts, with a recess to embrace a collar on the journal part of the axle, or the equivalent thereof, substantially as described, when this is combined with the mode of securing together the section of the said box, by fitting it within the hub or pipe box, and securing it therein by a nut which embraces the several sections, and which secures them within the hub or pipe box, substantially as specified."

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45. For an *Improvement in the Motion of the Lay in Looms;* John Goulding, Worcester, Massachusetts, June 15.

Claim.—"What I claim as my invention is, giving the lay of a loom one or more long beats for the shuttle to pass, or to insert a wire into the web, and as many short beats as may be necessary or desirable to strike up each thread of weft and wire, with a toggle joint, operated by a sweep or some other device, connected to or operated by a crank cam or otherwise."

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46. For an *Improvement in Derricks;* Selah Hill, Jersey City, New Jersey, and Chas. H. Dupuy, jr., Rondout, New York, June 15.

"This invention consists in placing the axis upon which the jib of a derrick, crane, or similar apparatus swings, in a position slightly deviating from the vertical, by which means, with a proper arrangement of hoisting tackle, the jib can be swung, and its swinging can be entirely controlled by the hoisting tackle, while it is raising the weight."

Claim.—"What we claim as our invention is, placing the axis upon which the jib swings, in a position deviating from the vertical, so as to cause the jib to have a tendency to swing in one direction, and applying the hoisting tackle, or part of the hoisting tackle, in any manner substantially as described, to the side opposite to the direction in which the jib tends to swing, so as to make the hauling on the said tackle, or part of the tackle, swing the jib in the opposite direction to that in which is its tendency to swing when left free."

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47. For an *Improvement in Preparations of Archil;* Leon Jarosson, City of New York, June 15.

Claim.—"Having thus fully described the nature of my invention, what I claim therein

as new is, mixing and treating lichen Rocellus with a volatile alkali, urine, and clear and fully saturated lime water, in the proportions and after the manner herein substantially set forth, for the purpose of producing a coloring matter known as archil."

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48. For *Improvements in Machines for Jointing Staves;* Edwin Jenney, Middleborough, and David Rood, Boston, Assignor to Edward Jenny, Middleborough, Massachusetts, June 15.

"The object of our improvement is, to enable the cutters, or the cutter heads, to adapt themselves to the formation of the bilge or curves of the edges of a stave, as well as to joint the same, whatever may be the width of the stave submitted to them."

Claim.—"What we claim as our invention is as follows: in combination with each carriage or frame, we claim the clamping contrivance or mechanism, by which such carriage is held firmly in position, after being moved outwards by a stave, and while such stave is being reduced on its edges, or has the bilge formed on it, such contrivance or mechanism consisting of the movable bar, the rocker bar, the lever, connecting rod, and the clamping lever; the whole being applied to each carriage, and made to act on it as specified.

"And in combination with the lever, as applied and operated in the manner above set forth, we claim the mechanism by which the fulcrum of the lever is caused to move longitudinally, or towards the cam, for the purpose of producing the effect, equivalent to shortening the rear arm of the lever, and lengthening the front arm thereof, whereby the cutter head is made to depart further from the middle of the machine, so as to increase the curve of the bilge, or make it, as it were, with a diminished radius, such mechanism being the stationary slotted plate underneath the carriage or frame, as arranged and made to operate essentially as described.

"And in combination with the cutters, which produce the bilge curve, we claim the self-adapting planes, or plane irons, arranged in front of such cutters, and for the purpose of jointing or smoothing the edges of the bilge, as explained."

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49. For an *Improvement in Saddles;* William S. Kennedy, Philadelphia, Pennsylvania, June 15.

"The nature of my improvement consists in employing, for the seat of the saddle, rattan, cane, or whalebone, or other material, substantially similar in its properties and operation, woven in the usual manner, of what is termed diagonal or chain weaving. Cane or rattan woven in this manner, has been long known and used, for forming the seats of chairs, and the manner of attaching the woven cane or rattan to the frame of the chair is also well known."

Claim.—"Having thus described my invention, what I claim therein as new is, the employment of woven rattan, cane, whalebone, or other similar elastic substance, in the construction of the seats of riding saddles, said seats, so constructed, being attached to and combined with the saddle-tree, in the manner and for the purposes above set forth."

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50. For a *Machine for Wiring Blind Rods;* Frederick H. Moore, Ithaca, New York, June 15.

Claim.—"Having thus fully, clearly, and exactly described my invention, what I claim is, 1st, The combining of clenching mechanism, substantially such as herein described, with devices for feeding the rod and the wire, and piercing the former, and severing, forming, and inserting the latter, whereby I make and firmly attach blind staples in their proper positions, substantially as herein described.

"2d, I also claim the pivoted clencher, arranged and actuated substantially in the manner herein specified."

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51. For an *Improvement in Hanging Mill Spindles;* Wm. H. Naracon, Auburn, New York, June 15.

"The nature of my invention consists in the use of linked sockets, for holding the upper stone upon the pivot of the spindle, and of an adjustable collar-bush, for holding the spindle to its step, constructed substantially as herein set forth."

Claim.—"What I claim as my invention is, the combination of the bail or balance rine, (of the usual shape,) with the cock-eye of the spindle, by means of the inverted bearing cup, whose shank presses up through, and is made fast in the centre of the said bail, and whose head is enclosed in the inverted socket, which rises above and is made fast to the top of the spindle, substantially as herein set forth."

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52. For an *Improvement in Bedstead Fastenings;* Adam S. Newhouse, Richmond Co., Georgia, June 15.

Claim.—"What I claim as my invention is, securing the rail to the post, by means of pin C, key D, and plate E, in the manner substantially as herein set forth."

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53. For an *Improvement in Meat Cutters;* Joseph Potts, Yocumtown, Pennsylvania, June 15.

Claim.—"Having thus fully described my improvements in meat cutters, what I claim therein as new is, the mode of attaching the knives herein described, by which they can be taken out and replaced expeditiously."

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54. For an *Improvement in Ore Stampers;* Thomas Reaney, Philadelphia, Pennsylvania, June 15.

"My improvement consists in adding weights above the stamper as the stamper wears away, so as to use it entirely up, or nearly so, before renewing it, which effects a great economy in the use of the stamper."

Claim.—"Having thus fully described my improved stamper and its mode of operation, what I claim therein as new is, the employment of weights upon the stamper, substantially as described, to keep up a uniformity of weight as the stamper wears, as herein set forth."

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55. For an *Improvement in Hand Seed Planters;* Gelston Sanford, Ellenville, New York, June 15.

Claim.—"Having thus described the nature and operation of my invention, what I claim as new is, the method of conveying seed from the seed box, and depositing it in the furrow or hill, substantially as herein shewn and described, viz: by having the rods attached in any proper manner to a staff, said staff rods passing vertically through the bottom of the seed box, the upper part of the rods having cups attached to them by elastic joints, the cups having spurs projecting from them, which cant or turn over the cups, when the staff and rods are raised, and throw the seed into the tops of the tubes, when they catch under the projections, the lower ends of the rods forcing out the seed from the tubes, when the staff is depressed, and the springs retaining it when the staff is raised."

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56. For an *Improvement in Harvesters;* William and Thomas Schnebly, City of New York, June 15.

Claim.—"1st, We claim as our invention, the arrangement of the bridges beneath the platform, in combination with chain bands, having accommodating knee formed fingers, or rakes, working on pivots and attached thereto, substantially as described.

"2d, We also claim working the vibrating cutter between an under and an upper open guard or finger, as described and represented."

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57. For an *Improvement in Label Cards;* James Sharp, Roxbury, Massachusetts, June 15.

Claim.—"I claim the manufacture of label cards or tickets, of cloth and paper, struck and pressed together, substantially as above described."

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58. For an *Improvement in Machines for Making Cordage;* David Perry, Assignor to F. & J. W. Slaughter, Fredericksburg, Virginia, June 15.

Claim.—"Having thus fully described my improved rope and cordage making machine,

what I claim therein as new is, 1st, The arrangement and combination of the parts by which the machine is enabled to stop itself, when the sliver becomes exhausted, or nearly so, in any one of the cans, viz: by means of the movable bottoms, within the cans, connected to the rods, which pass through the tubular journals of the can frames, and descend below the disk, the arm fixed near the centre of the spring shaft, and the arm fixed near the projecting end of the said shaft, and the arm projecting from the side of the machine, or the respective equivalents of the said parts, when arranged, combined, and operating with each other and with the fixed pulley, and the loose pulley on the shaft, substantially in the manner herein set forth.

"2d, I also claim the corrugating of the sides of the cans, to prevent the sliver from rising therein, when it is pressed into the same, by which a much larger quantity of sliver can be placed in them, than can be placed in cans of the usual form.

"3d, In combination with the said corrugations in the sides of the cans, I also claim the perforating of the sides of the same, for the purpose of allowing the air to escape therefrom, when the sliver is compactly pressed into the cans.

"4th, I also claim the inserting of a wing, or wings, into each of the cans, for the purpose of preventing the combined annular and rotary motion which is imparted to the cans from twisting and kinking the slivers, as they rise therein to the upper tubular journals of the can frames, substantially as set forth."

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59. For *Improvements in Sewing Machines;* Allen B. Wilson, Assignor to N. Wheeler, A. B. Wilson, Alanson Warren, and E. P. Woodruff, Watertown, Connecticut, June 15.

Claim.—"What I claim as my invention is, the combination of the bobbin for carrying one thread, with a rotating hook, which is of such form, or forms part of a disk, or its equivalent, of such form, as to extend the loop on the other thread, and pass it completely over the said bobbin, whereby the two threads are interlaced together; the parts being arranged and operating in any way substantially as herein set forth."

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60. For an *Improvement in Machine for Stamping Ores;* Virgil Woodcock, Swanzey, New Hampshire, June 15.

Claim.—"I do not claim as my invention, the combination of the drum or pulley, K, the strap, I, the frame, B, its catch lever, and the cam at the top of the gins, as employed to elevate the ram or weight, and disengage it, so as to enable it to fall down on the bed or mortar; nor do I claim the arc, g^1, of cogs, and the two gears, N N^1, (applied to their two shafts,) for the purpose of alternately imparting a rotary motion to each shaft, as I am aware that such are old contrivances; but what I do claim as my invention is, the combination and arrangement of the said arc of cogs, and its wheels, the two spur wheels, N N^1, the shafts thereof, the drums, K K^1, straps, I I^1, frames, H H^1, their catch levers, and disengaging cams; the whole being applied to the two weights or rams, and made to operate, or alternately raise them, disengage them, allow them to fall, and afterwards re-engage them, all as specified.

"And in combination with the two spur gears, N N^1, and the arc gear, g^1, P, I claim the cam, k, on the wheel, P, the two spring catches i i^1, and the two pins or studs, h h^1, all arranged, applied, and made to operate, substantially in the manner and for the purpose as herein before specified."

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61. For an *Improvement in Friction Clutch;* Wendell Wright, City of New York, June 15.

Claim.—"I do not claim as my invention, making a loose pulley fast with its shaft, by means of the friction of internal segments; but what I do claim as my invention is, operating the segments for producing friction on the inner surface of a loose pulley, by means of a thimble on the shaft of the pulley, connected with the segments by diagonal rods or braces, substantially as described."

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62. For an *Improvement in Detaching Harness from Horses;* George Yellott, Bel Air, Maryland, June 15.

"The nature of my invention consists in so constructing the hames and saddle-tree of

the harness as to enable the driver, at any time, by a single pull of a cord, to detach the horse from the vehicle, so that the animal, stripped of the harness, goes off with nothing but his collar, bridle, and reins attached."

Claim.—"What I claim as my invention is, the manner of constructing the hames, the saddle-tree, guard, and stop, as herein above described, so as to enable the driver, at any time, to detach the horse, or horses, from the harness and buggy, carriage, or other vehicle, by a single pull or jerk of a cord."

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63. For a *Machine for Washing and Amalgamating Gold, etc.;* Alexander Barclay, Newark, New Jersey, June 22.

Claim.—"What I claim as my invention is, the manner herein described of constructing the hollow revolving cylinder, to wit: with brackets along its periphery, and an inner partition near its discharge end, for separating, washing, and causing gold to amalgamate, in the manner herein described."

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64. For an *Improvement in Valves for Pumps;* Joel R. Bassett, Cincinnati, Ohio, June 22.

Claim.—"What I claim as new is, the device, consisting of a cylindrical box-valve, with its inducting openings, and its side or water way openings, and its eduction openings, and of a valve chest adapted thereto, with its induction, and side or water way, and eduction openings, corresponding to the openings in the valve box; the whole, in connexion with the usual water ways and barrel of a double acting pump, furnishing the parts necessary to the operation of such a pump; thus obtaining from a single valve, deriving its motion from the out-flowing and in-flowing currents, the result for which several separate valves have hitherto been needed, substantially in the manner described."

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65. For an *Improvement in Bomb-Lance for Killing Whales;* Christopher C. Brand, Ledyard, Connecticut, June 22.

Claim.—"What I claim as my invention is, the mode of sustaining the fuse rope in the fuse tube, and preventing the fire of the charge of the gun from passing by the fuse rope and into the bomb, viz: by the two metallic tubular plugs, cast around the ends of the fuse rope and into the fuse tube, and arranged substantially as specified.

"I do not claim the application of wings or feathers, to a shaft or rod, to direct its passage through the air; but what I do claim is, my improved mode of making them, viz: of vulcanized india rubber, or other equivalent, so that they may not only resist the destructive powers of the explosion, but be folded down on the shank, when put into a gun barrel, and have the property of elasticity, such as will enable them to unfold themselves after being discharged from the gun."

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66. For an *Improvement in Heat Radiator;* Merrill Colvin, Rochester, New York, June 22.

Claim.—"Having described the construction and operation of my heat radiator, what I claim as my invention is, the combination of the flue, I I, the cylindrical flue, the flue H, the receiver, G, the pipes, L L, and the open space, P; all operating in the manner and for the purpose as herein described and set forth."

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67. For an *Improvement in Horse Powers;* Aaron D. Crane, Newark, New Jersey, June 22.

Claim.—"What I claim as my invention is, 1st, The method of combining and arranging the two pallets as constructed, by a joint with the levers in such a manner, that by the action of the teeth of the main wheel against the end of these pallets, an oscillating motion is given to the levers; and by such motion, and the aid of the connecting rods and cranks, a rotary motion is produced; but I do not claim the application of connecting rods and cranks, for producing such rotary motion.

"2d, I do also claim the method of combining and arranging with the parts above claimed, the three eccentric wheels, running together in such a manner, that while the motion of the middle one is uniform, that of the other two on which the cranks act, is

irregular alternately; that irregularity being required, for the purpose of giving to the middle eccentric wheel a direct motion, not subject to being reversed, as it would be by using common wheels; all as herein before described for the purposes set forth.

"3d, I do not intend, by the foregoing claim, to limit myself to the application of this invention to horse powers, but to apply it as I may think proper, to other purposes, for driving machinery, when speed is required."

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68. For an *Improvement in Dumping Wagon;* Abm. V. Cross, Washington, District of Columbia, June 22.

"The nature of my invention consists in so arranging a wagon as to adapt it to the ordinary purposes of road use, and by a mechanical device, enable the person having it in charge to readily discharge the load by dumping; the body, by its own weight, causing it to sink on an adjustable lever or inclined plane, simply arranged, and not liable to the objections and difficulties of complex contrivances."

Claim.—"What I claim as my invention is, the arrangement of the adjustable bar, or incline, and screw, in combination with the rollers, all operating in the manner substantially as shown and set forth in the foregoing specification and accompanying drawings."

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69. For *Improved Wrought Nail Machinery;* Daniel Dodge, Keeseville, New York, June 22.

"My invention is such a combination and arrangement of the cutter, gripers, and hammers, that when a rod of suitable dimensions is introduced into the machine, a piece of sufficient length to form a nail will be cut off, caught into gripers, and passed under a series of hammers, receiving one stroke from each, as it progresses, and revolving during its transition, from one hammer to another, so that its different sides may be acted on alternately, until it has passed the entire series and is reduced to the requisite size and form, after which it is discharged."

Claim.—"Having thus described the nature of my invention, what I claim as new, is as follows: 1st, I claim the combination of a series of hammer faces with gripers, having both a rotary and progressive motion, and so arranged as to convey the blank between the several pairs of faces successively, at the same time revolving it so as to present different sides successively to the action of the hammers.

"2d, I claim such an arrangement of the several hammer faces, which act successively upon the blank, with regard to the distance of the lines in which they respectively move from the line in which the gripers move, that when the gripers move forward in said line, thereby conveying the blank from one pair of faces to another, the successive strokes which it receives, will fall on different points, thereby reducing different parts of it, successively, to the required size.

"3d, I claim, in combination with such an arrangement of the faces, with respect to the gripers, such a graduation, in the nearness with which the several pairs respectively approach, when they strike, that the several parts of the blank, upon which they respectively act, will be reduced to different sizes, and that the combined effect of the whole will be to reduce the nail to the proper form.

"4th, I claim the combination of the two kinds of faces, broad and narrow, with gripers so arranged as to present the blank to the action of the narrow ones, until it is suitably elongated, and subsequently to that of the broad ones, to receive a finish.

"5th, I claim the arrangement of a set of gripers upon the interior of a circular hub or frame, in combination with hammers placed in or near the centre of the circle in which they are arranged.

"6th, I claim adjusting the gripers, by means of a spring, or its equivalent, so arranged as to press them towards the hammers to their proper place, allowing them to recede as far as the lengthening of the nail requires, while the hammers are acting, and causing them to return again when the hammers are withdrawn.

"7th, I claim such a combination of stops for limiting the approach of the hammers to each other, with cams, or their equivalents, for forcing them together, as to diminish the inequality which unequal resistance between the faces, has a tendency to cause the springing of the parts which produce the stroke, thereby rendering the effect of the strokes uniform."

70. For an *Improvement in Sewing Machines;* Wm. O. Grover, Boston, and Wm. E. Baker, Roxbury, Massachusetts, June 22.

Claim.—"Having thus described our improved sewing machine, what we claim as our invention is, the arrangement above described, in a sewing machine, for feeding the cloth along, consisting of a notched bar, which has a vertical or up and down motion, for fastening the cloth upon, and releasing it from the notches of said bar, by striking it against a yielding plate, and a lateral motion, or motion forward and back, for feeding the cloth along after each stitch, substantially as above set forth.

"We also claim a circular, instead of a straight, horizontal needle, for spreading the loop of the thread of the vertical needle, substantially as above described."

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71. For an *Improvement in Foot Car;* Nehemiah Hodge, North Adams, Massachusetts, June 22.

Claim.—"Having thus fully described my invention, what I claim in the construction of foot cars as new is, suspending each of the treddles upon which the passenger operates from the same side of the axle, the treddles being so arranged as to rotate the axle, whetner they be applied both together, or one at a time, alternately, and through said axle, give motion to the driving wheels, substantially as herein described.

"I also claim combining with the axle and driving wheels, the fixed ratchets and spring pawls, for the purpose of giving the driving wheels a continuous motion in one direction, whilst the axle may have an intermittent motion in the same direction, as herein represented and described."

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72. For an *Improvement in Clover Harvesters;* John Krauser, Reading, Pennsylvania, June 22.

Claim.—"What I claim as of my invention is, the hinged board, in combination with the movable cutter frame and the platform, as herein set forth.

"2d, I claim the shield, the same being constructed, applied, and operated in the manner and for the purposes herein set forth and described.

"3d, I claim the combination of the lever, *f*, and lever, *n*, the latter being constructed at its posterior end, with slot and pivot pin, to admit of antero-posterior movement, and at its anterior end, with supports for cogged gearing, so that while the levers raise and depress the cutters, they also contribute to connect and sustain the gearing for driving the cutting reel."

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73. For an *Improvement in Divided Railroad Car Axles;* Wm. S. Loughborough, Victor, New York, June 22.

Claim.—"I do not claim surrounding a divided axle with a tube; neither do I claim making semi-axles of a conical form; but what I do claim as my invention is, the conical semi-axle, in combination with the tube, constructed as described, for the double purpose of giving the greatest strength to the axle itself with a given weight of metal, and of increasing the strength of the tube in the centre, without a corresponding increase of the external diameter thereof.

"Again, I do not claim a hollow divided tube, attached rigidly to the wheels and revolving upon an undivided axle, to which it is secured by flanches, wings, and bolts; but what I do claim is, the peculiar manner of coupling the wheels and semi-axles to the hollow tube surrounding said axles, by the use of the groove in the hub of the wheel into which the flanch of the tube enters, in combination with the wing secured to the wheel by bolts as described, for the threefold purpose, first, of enabling the wheel and semi-axle to revolve, independent of the tube, and of strengthening the axle at its weakest point where it enters the wheel; and lastly, to prevent the end of the tube from splitting out, by thus removing half the strain from the lower to the upper side, in the manner above set forth."

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74. For an *Improvement in Steps and Bearings in Mill Spindles;* Theodore S. Minniss, Meadville, Pennsylvania, June 22.

"My invention consists in sustaining and upbearing the gudgeons of shafts for mill spindles and other revolving bodies, upon, or by the pressure of fluids, in such a manner that the friction is vastly diminished, as hereinafter more fully described."

Claim.—"Having thus fully described my invention, I would observe that I do not claim upbearing or sustaining the gudgeons of shafts, or other revolving bodies, by liquids, when packing and force pumps are used, for giving the desired pressure, to sustain the weight of said shaft, or other body, and to prevent the lubricating liquid from overflowing; but what I do claim as new is, lessening the friction of mill spindles and other heavy revolving bodies, by upbearing and sustaining the gudgeon of the same upon any lubricating liquid, by the use of the hollow lighter, or case, *b*, with the case, *a*, for containing said liquid, upon which said lighter revolves, or their equivalents; said lighter being proportioned to the weight it is designed to sustain, and arranged and connected with the shaft, as described, or in any other manner substantially the same in principle, operation, and effect."

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75. For an *Improvement in Planing Machines;* Nicholas G. Norcross, Lowell, Massachusetts, June 22.

Claim.—"I do not claim as my invention, the combination of one or more stationary planes, so arranged, that while one or more remove the rough surface of a board, the rest or last shall finish or producee on it a smooth plane surface; but I claim, when placed so as to operate on one side of a board, a cylindrical, rotary cutter, for roughing and reducing, which cuts from the unplaned to the planed surface, in combination with a stationary cutter, placed behind, and as near thereto as may be, for finishing without pressure rollers or pressure bars of any kind, whereby I am enabled to operate with greatly diminished power, and the rotary cutter will cut up and throw off the shavings from the stationary cutter, and the boards will be reduced to an equal thickness and a smooth surface."

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76. For an *Improvement in Machines for Preparing Flocks;* John R. Peters, City of New York, June 22.

Claim.—"What I claim as of my invention is, 1st, the construction and arrangement of the fan wheel, and its combination with the elastic grinding bed or grater, constructed as described, or in any other manner substantially the same, for effecting the feeding, separating and discharging of the flocks and other matters mixed therewith, in the manner described.

"2d, I claim supporting or attaching the concave grater or grinding bed to the frame by springs, or other elastic material, for the purpose set forth.

"3d, I claim the reflectors and their arrangement in the machine, in the manner and for the purpose set forth; the whole being combined and operating substantially as described herein."

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77. For *Improvements in Fluid Metres, &c.;* William H. Lindsay, City of New York, June 22.

Claim.—"What I claim as my invention is, in combination with a force pump and a piston, or plunger, actuated by water or other fluid, forced from the same, the air vessel and the drop valve arranged and actuated substantially as described, whereby the measuring piston or plunger is caused to pause at the end of each stroke, in either direction, substantially in the manner and for the purposes described.

"I also claim supplying the pump chamber and the metre chamber, through valves, arranged and operating as described, and loaded in proper relative proportions, or supplied from heads of proper proportional height, for the purpose herein described, height of head of supply, or amount of load on the valves, being equivalents, producing the same results.

"I also claim actuating the counter through the agency of a rack and a segment cog, arranged substantially as described, whereby any movement of the metre piston or plunger, less than a whole stroke, is counted up in proper proportion by the counter."

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78. For an *Improvement in Ploughs;* David Swartz, Thomas Brook, Virginia, June 22.

Claim.—"Having thus fully described and represented my improved plough, what I claim therein as new is, combining a plough and harrow in one implement; that is to say, attaching a comb, or rake, or its equivalent, to the rear and upper end of the mould board, to comb out and pulverize the soil on the bottom of the furrow as it is turned up, substantially as set forth."

79. For an *Improvement in Time Pieces;* S. R. Wilmot, New Haven, Connecticut, June 22.

"The nature of my invention consists in connecting the corners or pillars of the clock-frame, to the sides or thickest parts of the case, thereby forming the junction of the said frame and case, at or between their most solid parts; and my invention further consists in supplying india rubber, or its equivalent, so as to interrupt all communication of solid matter between the clock and its case."

Claim.—"What I claim as my invention is, insulating or separating the clock frame, from all contact with the case, by intermediate packings of india rubber, or other non-conductor of sound, substantially as shewn and set forth."

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80. For an *Improvement in Imitation of Stone;* Charles Iles, Birmingham, England, June 15, 1852; patented in England, April 26, 1849.

Claim.—"Having thus described the nature of my invention, and the manner of performing the same, I would have it understood that I do not confine myself to the details as herein described, so long as the peculiar character of either part of my invention be retained; but what I do claim is, the production of ornamental surfaces on picture frames, inkstands, and other articles, and on walls, and other places, and on different matters, by applying thereto colored silk, waste, or other colored fibrous substances, combined with cement, in such manner that the colored silk, waste, or other colored fibrous matter used, shall produce a veined, or marbled character."

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81. For an *Improvement in Mill Stone Dress;* Wilson Ager, Rohrsburg, Pennsylvania, June 29.

Claim.—"Having thus fully described the nature of my invention, I wish it to be understood, that I do not claim the polishing of one stone by rubbing it with another of the same material; neither do I claim polishing the face of mill stones by rubbing it with another stone; as both these have been essayed. But what I do claim as my invention is, 1st, the rounding off of what is usually termed the feathered edge of mill stones for grinding buckwheat, so as to present a round, smooth surface, instead of a cutting edge, as herein set forth; and this I claim, whether said furrows are polished, sharpened, or straightened, by rubbing the same with a burr-block after said furrows have been roughed out with a pick or other tool, or by any other means substantially the same."

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82. For an *Improvement in Hulling Buckwheat;* Wilson Ager, Rohrsburg, Pennsylvania, June 29.

Claim.—"Having thus fully described my invention, what I claim therein as new is, the method herein described of scouring or hulling buckwheat, by passing it through between horizontal stones, the runner having furrows on its face, drafted substantially as herein represented, and cut in the direction of the motion of the stone, with the design of keeping the grain from leaving the stone too fast, and for rotating them both on their short and long diameters, and the bed stone left without furrows, in the manner and for the purpose herein set forth."

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83. For an *Improved Sail Hank;* Samuel Barker, City of New York, June 29.

Claim.—"Having described the nature of my invention, what I claim is, the construction of a divided hank, so formed that one part may embrace the stay, and the other part enter the eyelet of the sail, and the parts be connected together by the socket, or one receiving the shank of the other, and be confined by the bolt, for the purpose of securing sails to the stay, substantially in the manner set forth and shown."

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84. For *Apparatus for Propelling Vessels;* Matthew A. Crooker, City of New York, June 29.

"The principle aimed at by me in this invention is, to produce a movement somewhat in imitation of that employed in nature by aquatic birds for their propulsion, as ducks, geese, &c.; in place of the contraction of the paddle, to represent the movement of the

foot, the former is lifted from the water, but the act of propelling is sought to be the same."

Claim.—"What I claim as my invention is, the combination of the radius bars, upright levers, cranks, horizontal levers, carrying paddles, and curved slots, arranged with respect to each other, and connected and operating substantially in the manner set forth herein."

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85. For an *Improved Revolving Last Holder;* Henry C. De Witt, Napanock, New York, June 29.

Claim.—"What I claim as my invention is, 1st, The revolving stock, constructed, and arranged, and operating in the manner substantially as and for the purpose herein set forth.

"2d, The revolving last holder, attached to the revolving stock, and having an adjustable rest or arm; the whole being constructed, arranged, and operating in the manner substantially as and for the purpose herein specified."

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86. For an *Improvement in Railroad Car Trucks;* Caleb R. Disbrow, Bath, New York, June 29.

Claim.—"Having described the nature of my improved safety truck for railroads, what I claim is, the construction of a truck with independent wheel frames, strengthened by braces, and connected to the opposite side wheel frame, by the bar extending across the truck, upon which said wheel frames may vibrate, substantially in the manner and for the purposes set forth and shown."

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87. For an *Improvement in Potato Diggers and Stone Gatherers;* John T. Foster, City of New York, June 29.

Claim.—"Having now set forth the nature of my invention, what I claim is, the use of the roller, having a series of rows of pins in its periphery, and secured on an axle-tree of a cart or other moving apparatus, in combination with an adjustable apron having teeth in it, and a discharging plate having teeth in it, substantially for the purpose of gathering stone, potatoes, fruit, or other substances or articles, and depositing them in a box, as herein before set forth."

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88. For an *Improved Lock;* Francis Garachon, City of New York, June 29.

"The nature of my invention consists in the arrangement of the lock, a check lever and its accessories, for latching and unlatching the bolt, relatively to a check lever for locking the revolving plate, whereby the auxiliary key acts upon the former by being lifted endwise, and upon the latter by its bit, when revolving in the usual manner."

Claim.—"What I claim is, the arrangement of the lever and its accessories, for latching and unlatching the bolt, relative to the lever, or locking the revolving key-plate, whereby the auxiliary key acts upon the former by being lifted endwise, and upon the latter by its bit, when revolving in the usual manner, substantially as set forth."

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89. For an *Improvement in Hanging Steps of Mill Spindles;* Gideon Hotchkiss, Windsor, New York, June 29.

Claim.—"Having thus fully described my tram-block and bridge-tree, what I claim as my invention is, the manner of connecting the tram-block foundation with the stone bearers, by means of stanchions and screw-bolts, as specified, in combination with the method of suspending the lighter lever from the shell which guides and sustains the pot, containing the step of the spindle, by means of the shell, the sway bar, and the knife edges of the sway bar and pot, or their equivalents, in manner and for the purposes substantially as described."

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90. For an *Improvement in Bedstead Fastenings;* Jasper Johnson, Genesee, New York, June 29.

Claim.—"I do not claim a bedstead fastening composed of a stub bolt, drawn tight on an inclined plane, as that is well known; but what I do claim is, the combination of the

fastening, composed of the stub bolt and the inclined plane, or their equivalents, drawn tight by the cording of the bedstead, with the endless screw, acting upon the inclined plane by means of cogs or other equivalent device, in order, by turning the inclined plane under the bolt, to loosen, separate, or tighten again the fastening, without the necessity of slacking the cording."

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91. For *Improvements in Moulding Hollow Ware, &c.;* James J. Johnston, Cincinnati, Ohio, June 29.

Claim.—"What I claim as new is, the method of moulding hollow ware, or other similar castings, with a flaring rim or its equivalent, (such as the lip on cannon stove or other tubular castings,) by using third patterns, attached to suitable match plates or follow boards, and so devised that, in connexion with the first and second patterns which form the exterior, I mould therefrom the top edge, a portion of the interior of the desired casting, and a true seat for the core, thus, with the core, forming the entire mould, substantially as described and represented."

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92. For an *Improved Method of Heating Sheet Iron while in the Process of Manufacture;* Henry M'Carty, Pittsburg, Pennsylvania, June 29.

Claim.—"Having described my improvement in the manufacture of sheet iron, by which it is made to resemble the imported Russia sheet iron, and possess that beautiful mottled gloss and smooth hard surface, what I claim as new and of my invention is, heating the sheets of iron in a bath of hot lead, instead of heating them in an oven, by which the surfaces of the sheets are protected from the oxygen in the atmosphere, during the heating process, preparatory to the rolling operation."

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93. For an *Improved Compound Anchor;* Samuel Nye Miller, Roxbury, Massachusetts, June 29.

Claim.—"What I claim as my invention is, the above described anchor for holding ships."

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94. For an *Improvement in Mixing Mortar;* Jesse Peck, Buffalo, New York, June 29.

Claim.—"What I claim as my invention is, the mixing of lime and sand together, before straining, substantially in the manner and for the purpose herein set forth."

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95. For an *Improvement in Locomotive Engines;* Henry R. Remsen and P. M. Hutton, Troy, New York, June 29.

"This invention relates to the employment of a locomotive engine, of three cylinders, whose cranks are arranged at angles to each other of about 120°, with valves, valve chests, steam and escape pipes, so arranged as only to admit steam to one side of the pistons when the locomotive is advancing, and the other side when it is backing, the reversal being accomplished by such change of the operation of the steam, without recourse to any of the ordinary means of reversal."

Claim.—"What we claim as our invention is, the combination in a locomotive engine, of three cylinders, whose cranks are at angles of about 120° to each other, with valves, valve chests, escape pipes, and steam pipes, provided with throttle valves, substantially such as are herein described, whereby the steam acts only on one side of the pistons when the locomotive is advancing, and upon the other when it is backing, and the reversal is accomplished by such change in the operation of the steam, without recourse to any of the ordinary means of reversal."

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96. For an *Improvement in Skates;* Nathaniel C. Sanford, Meriden, Connecticut, June 29.

"The nature of my invention consists in a peculiar manner of forming the runner, viz. out of a plate of steel, tapered at one end, said plate, by means of a die or any other proper mode, being struck or thrown into the required form."

Claim.—"Having thus described my invention, what I claim as new is, making the

runner out of a plate of steel, and of the form substantially as shown and specified, the plate being turned or struck the desired form by means of disks, or in any other desirable way."

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97. For an *Improved Belt Clasp;* Albert M. Smith, Rochester, New York, June 29.

Claim.—"What I claim as my invention is, the making clasps to fasten belts or bands together, to run on machinery or around pullies, by using jaws or plates of metal, constructing and adapting them to that purpose, and then confining them together with screws, so as to hold the belts solid, and thereby introducing a new and useful manner of fastening machine belts together."

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98. For an *Improvement in Method of Ringing Bells;* Thomas V. Stran, New Albany, Indiana, June 29.

Claim.—"What I claim as my invention is, the combination and arrangement of the levers and the compound levers, so connected and attached to the axle as to give motion to the bell clapper, in the manner and for the purposes herein shown and set forth."

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99. For an *Improvement in Brick Machines;* R. A. Ver Valen, Haverstraw, New York, June 29.

Claim.—"I do not claim the plunger or follower, operated by a connecting rod or crank, as that is well known; but what I claim as new is, 1st, The employment or use of the lever H, having step projections, b^1 b^2, on one of its sides, attached to the connecting rod, C, and arranged as shown and described, by which a greater or less pressure of the plunger or follower upon the clay in the moulds is obtained, as desired.

"2d, I claim the arrangement of the levers, I, J, N, rods, K, L, vertical lever, M, and the rod, O, with the levers, P, S, and upright shaft, R, for the purpose of operating the feeder, T, and vibrating bar, U, substantially as set forth.

"3d, I claim the employment or use of the spring, Y, attached to the vertical lever, M, and operated upon by the rods, *r*, *r*, attached to the lever, whereby the working of the machine is prevented by any obstruction, as described.

"4th, I claim the attaching together of the feeder, T, and vibrating bar, U, the vibrating bar having a guide rod, *m*, working in suitable bearings, *n*, *n*, or arranged in any other suitable way."

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100. For an *Improvement in Sofa Bedsteads;* Alfred Walker, New Haven, Connecticut, June 29.

Claim.—"What I claim as my invention is, the manner of guiding the seat when it is raised and lowered, and of connecting the seat and bed when extended, by means of the metallic bearings, and the grooves which they traverse, when the seat is raised and lowered."

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101. For an *Improvement in Railroad Cars;* Charles Waterbury, Bridgeport, Connecticut, June 29.

"The nature of my invention consists in constructing the ends of railroad cars in such a manner, that an enclosed communication may be had from one car to the other, so as to protect the lives of passengers while passing from one car to the other."

Claim.—"What I claim as my invention is, an enclosed passage or communication from one car to the other, as herein described, for the purpose of ventilating the train through the ends of the cars, from the forward part of the train, and for the safety of the passengers, while passing from one car to the other, and for the purpose of keeping dust out of the cars, when the train is in motion."

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102. For an *Improvement in Connecting Cocks with Pipes;* Daniel A. Webster, City of New York, dated June 29, 1852; ante-dated December 29, 1851.

Claim.—"Having thus fully described my invention, what I claim therein as new is, the manner herein described of making a tight joint, viz: by boring the hole in the pipe as

nearly cylindrical as may be, and making that part of the cock which is to be inserted, near the end and near the shoulder, of equal diameter with the holes, and the central part slightly larger, and then driving the cock into its place—the edges of the hole shaving the cock to its proper size and form.

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103. For an *Improvement in Sugar Boiling Apparatus;* Juan Ramos, Island of Porto Rico, Assignor to James C. Gallagher, Philadelphia, Pennsylvania, and William F. Tirado, Ponce, Island of Porto Rico, June 29; patented in Spain, April 29, 1851.

Claim.—"What I claim as my own invention and discovery is, the construction of the transverse canal, in combination with the hinged cover, for the double purpose of returning the froth to the receiving pans, and for preventing the syrup from falling into the canal, while being laded from one pan to the other.

"I also claim the construction of the lower longitudinal canal, with its hinged board, for the purpose of more effectually removing the feculencies, as described.

"I also claim the use of the movable plank in the coolers, which when removed, leaves a vacancy or channel for the molasses to flow away to the discharge aperture, through the bottom of the cooler."

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104. For an *Improvement in Processes for the Manufacture of Sugar;* Juan Ramos, Island of Porto Rico, Assignor to James C. Gallagher, Philadelphia, Pennsylvania, and William F. Tirado, Ponce, Island of Porto Rico, June 29; patented in Spain, April 29, 1851.

Claim.—"What I claim as my own invention and discovery is, the use of the juice of the plaintain stalk and quicklime combined, substantially in the manner and for the purpose described, for defecating the cane juice.

"I also claim the application of a fresh strike of concentrated syrup from the battery to the molasses first drained off, for the purpose of crystalizing the sugar yet remaining in the molasses."

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105. For an *Improvement in Revolving Boot Heels;* Thomas Walker, Birmingham, England, Assignor to Benjamin B. Thayer, Quincy, Assignor to Wm. W. Churchill, Boston, and John Baxter, Quincy, Massachusetts, June 29; patented in England, July 1, 1849.

Claim.—"What I claim as my invention is, the combination of the four separate pieces, that is to say, the metallic ring, the leather or flexible disk, the leather annulus or ring, and the leather disk, the said combination being represented in fig. 1, and constructed, arranged, and made to operate together, substantially as herein before described."

Re-issues for June, 1852.

1. For an *Improvement in the Machine for Cutting Paper and Trimming Books;* Frederick J. Austin, City of New York; dated June16, 1841; ante-dated December 16, 1840; re-issued June 22, 1852.

Claim.—"What I claim as my invention is, the use of a knife having a lateral or end vibratory motion, for the purpose of cutting the edges of books, paper, &c., and its combination with the frame and rods, or either of them, and operated by cams or other equivalent devices, to give a drawing and vibratory cutting action to the knife, substantially as set forth.

"I claim also the mechanical construction of the press, as arranged and combined with the parts for cutting and pressing, thereby forming an entire machine for the purpose described."

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2. For an *Improvement in Batting of Cotton, or other Fibrous Material;* Hamilton B. Lawton and Hiram T. Lawton, Troy, New York; patented March 13, 1849; re-issued June 22, 1852.

Claim.—"We do not claim as our invention the mode of operating a series of carding

machines to make batting, as shown by J. Essex's drawings, nor any part of the above described machine. What we do claim as our invention and discovery is, the method of making batting or wadding by laying on and covering both the upper and lower surfaces of a sheet or sheets of cotton, wool, hair, or other elastic fibrous material, that has been merely well picked, cleaned, and spread, with layers of carded, condensed, and compact fibres, such as cotton, wool, hemp, &c., for the purpose of rendering the same smooth, strong, and more suitable for bedding, wadding, and upholstery uses."

DESIGNS FOR JUNE, 1852.

1. For a *Design for a Portable Grate;* David Thomson, Boston, Massachusetts, Assignor to New Market Iron Foundry, of Boston, June 8.

Claim.—"What I claim as my production is, the new design, consisting of the sunken panels, leaf scrolls, and ornamental mouldings, herein above described and represented in the drawings, for the front of a portable grate."

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2. For a *Design for a Parlor Stove;* Samuel D. Vose, Albany, New York, June 22.

Claim.—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged together, the whole forming an ornamental design for a parlor stove, as herein set forth and described."

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3. For a *Design for a Coal Stove;* Samuel D. Vose, Albany, New York, June 22.

Claim.—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged together, the whole forming an ornamental design for a coal burner stove, as herein set forth and described."

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4. For a *Design for a Box Stove;* Samuel D. Vose, Albany, New York, June 22.

Claim.—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged, the whole forming an ornamental design for a box stove, as herein set forth and described."

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5. For a *Design for a Parlor Cook Stove;* Samuel D. Vose, Albany New York, June 22.

Claim.—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged together, the whole forming an ornamental design for a parlor cook stove, as herein set forth and described."

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6. For a *Design for a Dining Room Stove;* William L. Sanderson, Troy, Assignor to R. Finch, Sr., and Reuben Finch, Jr., Peekskill, New York, June 22.

Claim.—"What I claim as my invention is, the ornamental form, design, and configuration, as herein described and represented, of the stove as a whole, and also of the several plates, the feet, and vase, separately."

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7. For a *Design for a Cooking Stove;* S. W. Gibbs, Albany, New York, Assignor to North, Harrison & Chase, Philadelphia, Pennsylvania, June 22.

Claim.—"What I claim as my invention is, the design and configuration of the ornaments and mouldings herein described, constituting a design for a cooking stove."

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8. For a *Design for a Cooking Stove;* James H. Conklin, Assignor to R. Finch, Sr., and Reuben Finch, Jr., Peekskill, New York, June 29.

Claim.—"What I claim as my invention is, the design, combination, and arrangement of the several mouldings and ornaments upon the plates forming the stove, and also the configuration of the mouldings and ornaments upon each of the doors, and of the feet, substantially as described and represented."

MECHANICS, PHYSICS, AND CHEMISTRY.

Observations on Etherification. By THOMAS GRAHAM, F. R. S., F. C. S., &c.*

In the ordinary process of etherizing alcohol by distilling that liquid with sulphuric acid, two distinct chemical changes are usually recognised; namely, first, the formation of sulphovinic acid, the double sulphate of ether and water; and secondly, the decomposition of the compound named, and liberation of ether. The last step, or actual separation of the ether, is referred to its evaporation, in the circumstances of the experiment, into an atmosphere of steam and alcohol vapor, assisted by the substitution of water as a base to the sulphuric acid, in the place of ether. The observation, however, of M. Liebig, that ether is not brought off by a current of air passing through the heated mixture of sulphuric acid and alcohol, is subversive of the last explanation, as it demonstrates that the physical agency of evaporation is insufficient to separate ether. Induced to try whether ether could not be formed without distillation, I obtained results which appear to modify considerably the views which can be taken of the nature of the etherizing process.

The spirits of wine or alcohol always employed in the following experiments, was of density 0·841, or contained 83 per cent. of absolute alcohol.

Expt. 1.—One volume of oil of vitriol was added to four volumes of alcohol, in a gradual manner, so as to prevent any considerable rise of temperature. The mixture was sealed up in a glass tube, 1 inch in diameter and 6·6 inches in length, of which the liquid occupied 5·2 inches, a space of 1·4 inch being left vacant, to provide for expansion of the liquid by heat. The tube was placed in a stout digester containing water, and safely exposed to a temperature ranging from 284° to 352° (140° to 178° C.) for one hour.

No charring occurred, but the liquid measured on cooling, 5·25 inches in the tube, and divided into two columns, the upper occupying 1·75 inches, and the lower 3·5 inches of the tube. The former was perfectly transparent and colorless, and on opening the tube, was found to be ether, so entirely free from sulphurous acid, that it did not affect the yellow color of a drop of the solution of bichromate of potash. The lower fluid had a slight yellow tint, but was transparent. It contained some ether, but was principally a mixture of alcohol, water, and sulphuric acid. The salt formed by neutralizing this acid fluid with carbonate of soda, did not blacken when heated, from which we may infer that little or no sulphovinic acid was present.

The principal points to be observed in this experiment, are its entire success as an etherizing process, without distillation, without sensible formation of sulphovinic acid, and with a large proportion of alcohol in contact with the acid, namely, two equivalents of the former nearly, to one of the latter. When the proportion of the alcohol was diminished, the results were not so favorable.

* From the Journal of the London Chemical Society, Vol. III., 1851.

Expt. 2.—A mixture of one volume of oil of vitriol and two volumes of alcohol, sealed up in a glass tube, was heated in the same manner as the last. The liquid afterwards appeared of an earthy-brown color by reflected light, and was transparent and red by transmitted light. Only a film of ether was sensible after twenty-four hours, floating upon the surface of the dark fluid.

Expt. 3.—With a still smaller proportion of alcohol, namely, one volume of oil of vitriol with one volume of alcohol, which approaches the proportions of the ordinary etherizing process, a black, opaque liquid was formed at the high temperature, thick and gummy, without a perceptible stratum of ether, after standing in a cool state.

Crystals of bisulphate of soda, containing a slight excess of acid, were found to etherize about twice their volume of alcohol, in a sealed tube, quite as effectually as the first proportion of oil of vitriol, when heated to the same temperature. The two liquids found in the tube were colorless, no sulphurous acid appeared, and only a minute quantity of sulphovinic acid.

Crystals of bisulphate of soda, which were formed in an aqueous solution and without an excess of acid, had still a sensible but much inferior etherizing power.

Expt. 4.—A mixture was made of oil of vitriol with a still larger proportion of alcohol, namely, 1 volume of the former and 8 of the latter, or nearly 1 equivalent of acid to 4 equivalents of alcohol. This mixture was sealed up in a tube and heated for an hour between 284° and 317° (140° and 158° C.), which appeared sufficient for etherizing it. A second exposure for another hour to the same temperature did not sensibly increase the ether product. The column of ether measured 1·25 in the tube, and the acid fluid below 2·5 inches. Both fluids were perfectly colorless.

It thus appears to be unnecessary to exceed the temperature of 317° (158° C.) in this mode of etherizing, and that the proportion of alcohol may be increased to eight times the volume of oil of vitriol without disadvantage.

Expt. 5.—The proportions of the first experiment were again used, namely, 1 volume of oil of vitriol with 4 volumes of alcohol, and the mixture heated as in the last experiment to 317° (158° C.) The upper fluid, or ether, measured 1·1 inch in the tube; the lower fluid 2·65 inches. The latter had a slight yellow tint, like nitrous ether, but only just perceptible. It gave, when neutralized by chalk:

Sulphate of lime	. . .	83·11 grains.
Sulphovinate of lime	. .	4·91 "

The last salt was soluble in alcohol, and crystallized in thin plates.

Here again the formation of sulphovinic acid in a successful etherizing process is quite insignificant.

New results at 317°, from the other proportions of 1 volume of oil of vitrol with 1 and 2 volumes of alcohol, were quite similar to those obtained in experiments 2 and 3, at the higher temperature of 352°. In none of these experiments, did there appear to be any formation of olefiant gas, and the tubes could always be opened, when cool, without danger.

Neither glacial phosphoric acid nor crystalized biphosphate of soda etherized alcohol to the slightest degree, when heated with that sub-

stance in a sealed tube, to 360° (182°C.). Even chloride of zinc produced no more, at the same temperature, than a trace of ether, perceptible to the sense of smell.

Expt. 6.—To illustrate the ordinary process of ether-making, a mixture was prepared, as usually directed, of:

100 parts of oil of vitriol,
48 " of alcohol (0·841),
18·5 " of water.

This liquid was sealed up in a glass tube, and heated to 290° (143° C.) for one hour. It became of a dark greenish-brown color, and opalescent, with a gummy looking matter in small quantity. No stratum of ether formed upon the surface of the fluid.

The tube was opened and the fluid divided into two equal portions. One of the portions was mixed with half its volume of water, and the other with half its volume of alcohol, and both sealed up in glass tubes and exposed again to 290° for one hour.

It would be expected, on the ordinary view of water setting free ether from sulphovinic acid, that much ether would be liberated in the mixture above, to which water was added. The ether which separated, however, amounted only to a thin film, after the liquid had stood for several days. In the other liquid, on the contrary, to which alcohol was added, the formation of ether was considerable, a column of that liquid appearing, which somewhat exceeded half the original volume of the alcohol added. In fact, the sulphovinic acid was nearly incapable of itself of yielding ether, even when treated with water. But it was capable of etherizing alcohol added to it, in the second mixture, like bisulphate of soda or any other acid salt of sulphuric acid.

The conclusions which I would venture to draw from these experiments are the following:

The most direct and normal process for preparing ether, appears to be, to expose a mixture of oil of vitriol with from four to eight times its volume of alcohol of 83 per cent., to a temperature of 320° (160° C.), for a short time. Owing to the volatility of the alcohol, this must be done under pressure, as in the sealed glass tube. The sulphuric acid then appears to exert an action upon the alcohol, to be compared with that which the same acid exhibits when mixed in small proportions with the essential oils. Oil of turpentine, mixed with one-twentieth of its volume of sulphuric acid, undergoes an entire change, being chiefly converted into a mixture of two other hydrocarbons, terebene and colophene, one of which has a much higher boiling point and greater vapor-density than the oils of turpentine. This hydrocarbon does not combine with the acid, but is merely increased in atomic weight and gaseous density without any further derangement of composition, by a remarkable polymerizing action (as it may be termed) of the sulphuric acid. So of the hydrocarbon of alcohol; its density is doubled in ether, by the same polymerizing action. Chloride of zinc effects, with alcohol, at an elevated temperature, a polymeric catalysis of the latter, of the same character, but in which hydrocarbons are formed, of even greater density and free from oxygen.

This view of etherification is only to be considerd as an expression of

the contact-theory of that process which has long been so ably advocated by M. Mitscherlich.

The formation of sulphovinic acid appears not to be a necessary step in the production of ether; for we have found that the etherizing proceeded most advantageously with bisulphate of soda, or with sulphuric acid mixed with a large proportion of alcohol and water, which would greatly impede the production of sulphovinic acid. It appears, indeed, that the combination of alcohol with sulphuric acid, in the form of sulphovinic acid, greatly diminishes the chance of the former being afterwards etherized; for when the proportion of oil of vitriol was increased in the preceding experiments, which would give much sulphovinic acid, the formation of ether rapidly diminished. The previous conversion of alcohol into sulphovinic acid, appears, therefore, to be actually prejudicial, and to stand in the way of its subsequent transformation into ether.

The operation of etherizing has attained a kind of technical perfection in the beautiful continuous process now followed. The first mixture of alcohol and sulphuric acid is converted into sulphovinic acid, the sulphate of ether and water, which acid salt appears to be the agent which polymerizes all the alcohol afterwards introduced into fluid. Bisulphate of soda, with a slight excess of acid, acts upon alcohol in the same manner, and its substitution for the acid sulphate of ether would have a certain interest, in a theoretical point of view, although a change of no practical importance in the preparation of ether.

Sulphuric acid does not appear to be adapted for the etherizing of amylic alcohol. M. Balard, by distilling these substances together, obtained a variety of hydrocarbons, some of them of great density, but no ether. The polymerizing action of the sulphuric acid appears to advance beyond the ether stage. I have varied the experiment by heating amylic alcohol, in a close tube, to 350° (176° C.) with oil of vitriol, to which 1, 2, 3, 4, and even 6 equivalents of water had been added, without obtaining anything but hydrocarbons of Balard. The formation of these was abundant, even with the most highly hydrated acid, and with a very moderate coloration of the fluid.

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*W. & J. Galloway's Patent Improvements in Steam Boilers.**

In our last number we noticed, briefly, an arrangement of slides for steam engines, lately patented by Messrs. Galloway, in which double ports were employed to afford a better exit of the steam, with other advantages.

We, however, attach a greater importance to Messrs. Galloway's improvements in boilers, which embrace various arrangements of their CONICAL *water tubes*. We believe that boilers on this principle are destined to supersede the ordinary tubular boilers for steam navigation, and if the water tubes in America have not been entirely successful, we attribute it to their not adopting the conical form. We should be glad to see a series of experiments undertaken to prove the relative values of various kinds of boiler surface, for we are convinced that a considerable portion

* From the London Artizan, December, 1851.

of the surface of ordinary tubular boilers is inoperative. If we could reduce the cubic contents of our present boilers only 10 per cent., it would be a gain of no ordinary kind; and when we look at the difference between a flue and a tubular boiler, there appears no reason why as great an advance should not again be made. To illustrate the principle, we have sketched one of a set of four marine boilers, arranged so as to have one chimney, common to the four, in the centre. Fig 1 is a side elevation in section; fig. 2 a front view; fig. 3 a plan in section; and fig. 4 an

Fig. 1.

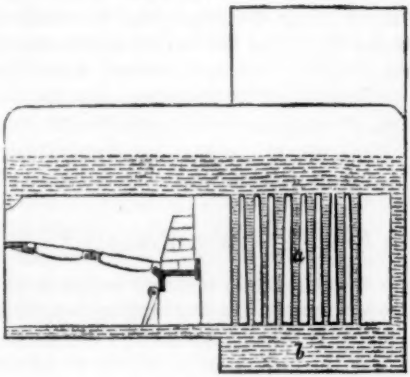


Fig. 2.

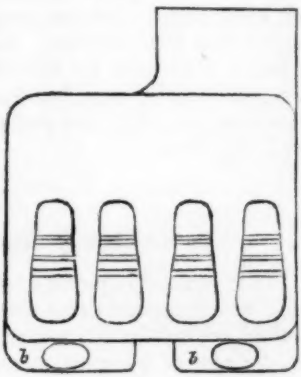


Fig. 3.

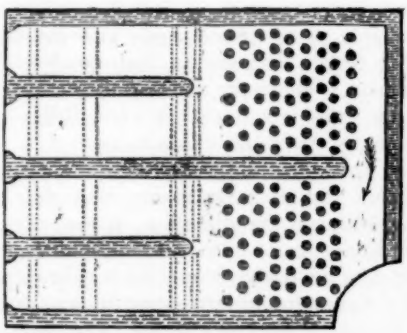
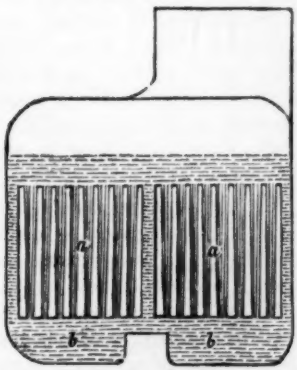


Fig. 4.



end elevation in section across the tubes. The vertical conical tubes, *a*, *a*, are arranged in two rectangular flues behind the furnaces, and are accessible at each end; water spaces of sufficient size, *b*, *b*, being constructed at the bottom, with suitable man-holes. These water spaces drop down between the keelsons, so that the boilers would not occupy any more height than ordinary ones. To return to the question of the value of heating surface. Although this point has never received the attention it deserves, it appears quite rational to suppose that a tube through which a current of water is passing will much more rapidly abstract the heat from the heated air which flows over it, than a tube in

which the current is sluggish, or as is the case with *small, long, cylindrical* tubes, when they are half filled with steam which cannot freely escape. The conical form provides for these requirements admirably. The inclined position of the sides affords a better surface for the flame to act upon, whilst the bubbles of steam, as they are formed, find room to rise freely. It will be observed that the tubes nearest the furnace are placed farther apart than those behind them. The reason for this is obvious. The progress of the flame is not so abruptly arrested, and the heat is diffused more equally over the whole number of tubes, which materially adds to their durability. We hope to be able to give, on some future occasion, a report on these boilers, a trial of which we await with great interest. Since we described the boilers constructed by Messrs. Galloway for the Gutta Percha Company, several have been erected in and around London; and it is a fact worth noting, that the tubes have proved, after two years' use, as durable as the best boilers of the ordinary form.

On the Lines of Magnetic Force. By Prof. Faraday.*

That beautiful system of power which is made manifest in the magnet, and which appears to be chiefly developed in the two extremities, thence called ordinarily the magnetic poles, is usually rendered evident to us in the case of a particular magnet by the attractive or repulsive effect of these parts on the corresponding parts of another magnet; and these actions have been employed, to indicate both the direction in which the magnetic force is exerted, and also the amount of the force at different distances. Thus, if the attraction be referred to, it may be observed either upon another magnet or upon a piece of soft iron; and the law which results, for effects beyond a certain distance, is, that the force is inversely as the square of the distance. When the distance of the acting bodies from each other is small, then this law does not hold, either for the surface of the magnets or for any given point within them.

Mr. Faraday proposes to employ a new method, founded upon a property of the magnetic forces different from that producing attraction or repulsion, for the purpose of ascertaining the direction, intensity, and amount of these forces, not to the displacement of the former method, but to be used in conjunction with it; and he thinks it may be highly influential in the further development of the nature of this power, inasmuch as the principle of action, though different, is not less magnetic than attraction and repulsion, not less strict, and the results not less definite.

The term line of magnetic force is intended to express simply the direction of the force in any given place, and not any physical idea or notion of the manner in which the force may be there exerted; as by actions at a distance, or pulsations, or waves, or a current, or what not. A line of magnetic force may be defined to be that line which is described by a very small magnetic needle, when it is so moved in either direction correspondent to its length, that the needle is constantly a tangent to the line of motion; or, it is that line along which, if a transverse wire be

* From the London Athenæum, February, 1852.

moved in either direction, there is no tendency to the formation of an electric current in the wire, whilst if moved in any other direction there is such a tendency. The direction of these lines about and between ordinary magnets is easily represented in a general manner by the well known use of iron filings.

The method of recognising and taking account of these lines of force which is proposed, and was illustrated by experiments during the evening, is to collect and measure the electricity set into motion in the moving transverse wire; a process entirely different in its nature and action to that founded on the use of a magnetic needle. That it may be advantageously employed, excellent conductors are required; and therefore those proceeding from the moving wire to the galvanometer were of copper 0·2 of an inch in thickness, and as short as was convenient. The galvanometer, also, instead of including many hundred convolutions of a long fine wire, consisted only of about 48 or 50 inches of such wire as that described above, disposed in two double coils about the astatic needle: and that used in the careful research contained only 20 inches in length of a copper bar 0·2 of an inch square. These galvanometers showed effects 30, 40, or 50 times greater than those constructed with fine wire; so abundant is the quantity of electricity produced by the intersections of the lines of magnetic force, though so low in intensity.

The lines of force already described, will, if observed by iron filings or a magnetic needle or otherwise, be found to start off from one end of a bar magnet, and after describing curves of different magnitudes through the surrounding space, to return to and set on at the other end of the magnet; and these forces being regular, it is evident that if a ring, a little larger than the magnet, be carried from a distance towards the magnet and over one end until it has arrived at the equatorial part, it will have intersected once all the external lines of force of that magnet. Such rings were soldered on to fitly shaped conductors connected with the galvanometer, and the deflections of the needle observed for one, two, or more such motions or intersections of the lines of force: it was stated that when every precaution was taken, and the results at the galvanometer carefully observed, the effect there was sensibly proportionate for small or moderate arcs to the number of times the loop or ring had passed over the pole. In this way, not only could the definite actions of the intersection wire be observed and established, but also one magnet could be compared to another: wire of different thickness and of different substances could be compared; and also the sections described by the wire in its journey could be varied. When the wire was the same in length, diameter, and substance, no matter what its course was across the lines of force, whether direct or oblique, near to or far from the poles of the magnet, the result was the same.

A compound bar magnet was so fitted up that it could revolve on its axis, and a broad circular copper ring was fixed on it at the middle distance or equator, so as to give a cylindrical exterior at that place. A copper wire being made fast to this ring within, then proceeded to the middle of the magnet, and afterwards along its axis and out at one end. A second wire, touched by a spring contact, the outside of the copper ring, and was then continued outwards six inches, after which it rose and

finally turned over the upper pole towards the first wire, and was attached to a cylinder insulated from but moving round it. This cylinder and the wire passing through it were connected with the galvanometer, so that the circuit was complete; but that circuit had its course down the middle of the magnet, then outwards at the equator and back again on the outside, and whilst always perfect, allowed the magnet to be rotated without the external part of the circuit, or the latter without the magnet, or both together.

When the magnet and external wire were revolved together, as one arrangement fixed in its parts, there was no effect at the galvanometer, however long the rotation was continued. When the magnet with the internal wire made four revolutions, as the hand of a watch, the outer conductor being still, the galvanometer needle was deflected 35° or 40° in one direction: when the magnet was still, and the outer wire made four revolutions as the hands of a watch, the galvanometer needle was deflected as much as before in the contrary direction: and in the more careful experiments the amount of deflexion for four revolutions was precisely the same whatever the course of the external wire, either close to or far from the pole of the magnet.

Thus it was shown, that when the magnet and the wire revolved in the same direction, contrary currents of electricity, exactly equal to each other, tended to be produced; and those outside resulted from the intersection by the outer wire of the lines of magnetic force external to the magnet; that wherever this intersection was made the result was the same; and that there were corresponding lines of force within the magnet, exactly equal in force or amount to those without, but in the contrary direction. That in fact every line of magnetic force is a closed curve, which in some part of its course passes through the magnet to which it belongs.

In the foregoing cases the lines of force, belonging as they did to small systems, rapidly varied in intensity according to their distance from the magnet, by what may be called their divergence. The earth, on the contrary, presents us, within the limits of one action at any one time, a field of equal force. The dipping needle indicates the direction or polarity of this force; and if we work in a plane perpendicular to the dip, then the number or amount of the lines of force experimented with will be in proportion to the area which our apparatus may include. Wires were therefore formed into parallelograms, inclosing areas of various extent, as one square foot, or nine square feet, or any other proportion, and being fixed upon axes equidistant from two of the sides, could have these axes adjusted perpendicular to the line of dip and then be revolved. A commutator was employed and associated both with the galvanometer and the parallelograms, so that the upper part of the revolving wire always sent the current induced in it in the same direction. Here it was found that rotation in one direction gave one electric current; that rotation in the reverse direction gave the contrary current; that the effect at the galvanometer was proportionate to the number of rotations with the same rectangular; that with different sized rectangles of the same wire the effect was proportionate to the area of the rectangle, *i. e.*, the number of curves intersected, &c. &c. The vicinity of other magnets to this magnet made no difference in the effect, provided they were not moved during the ex-

periments; and in this manner the non-interference of such magnets with that under investigation was fully established.

All these and other results are more fully stated and proved in papers now before the Royal Society. The general conclusions are, that the magnetic lines of force may be easily recognised and taken account of by the moving wire, both as to direction and intensity, within metals, iron or magnets, as well as in the space around; and that the wire sums up the action of many lines in one result: That the lines of forces will represent the nature, condition, direction, and amount of the magnetic forces; that the effect is directly as the number of lines of force intersected, whether the intersection be direct or oblique; that in a field of equal force, it is directly as the velocity; or as the length of the moving wire; or as the mass of the wire; that the external power of an unchangeable magnet is definite yet illimitable in extent; and that any section of all the lines of force is equal to any other section; that the lines of force within the magnet are equal to those without; and that they are continuous with those without, the lines of force being closed curves.—*Proc. Roy. Inst., Jan.* 23, 1852.

Observations on the Formation of Sulphuric Acid from Sulphurous Acid and Oxygen. By Prof. Wöhler.*

It is well known from the experiments of Dœbereiner, and other chemists, that several metallic oxides are capable, like platinum, of supporting the slow combustion of alcoholic vapor. I considered it highly probable that this action would likewise extend to a mixture of sulphurous acid gas and oxygen, and requested M. Mahla to make some experiments on the subject in such a manner that a dry mixture of about two volumes sulphurous acid and one volume oxygen or of atmospheric air were passed over oxide heated in a glass tube to a faint red.

1. *Oxide of Copper, Peroxide of Iron, Oxide of Chromium*, each separately employed, instantly cause the production of dense white fumes of sulphuric acid. A mixture of oxide of copper and oxide of chrome, prepared by precipitation, had in particular a very powerful action. The same amount of oxide appears capable of converting an unlimited quantity of the gases into sulphuric acid. The formation of sulphuric acid proceeds so readily, and to such an extent, that this process will undoubtedly come to be practically employed.

2. *Oxide of Copper and Oxide of Iron*, heated in sulphurous acid without oxygen, are reduced, the first to red protoxide, the latter to black protoperoxide, with production of vapors of sulphuric acid, but which, however, cease to appear as soon as the reduction is complete.

3. *Oxide of Chromium*, heated without oxygen in sulphurous acid, remains unaltered; not a trace of sulphuric acid is formed.

4. *Metallic Copper*, placed in a spongy state over mercury in a mixture of two volumes sulphurous acid and one volume oxygen, exerts at the ordinary temperature, even in the course of several days, no action upon the mixture of gases. But if the spongy copper be heated in it, fumes

*From the London Chemical Gazette, April, 1852.

of sulphuric acid are formed, but not before the copper has become converted on the surface into oxide.

5. *Caustic Lime*, heated in the gaseous mixture, becomes brightly incandescent, and is converted into sulphate without any formation of free sulphuric acid.

6. *Aqueous Vapor*, passed with the gaseous mixture through a porcelain tube at a faint red heat, does not induce the production of the hydrate of sulphuric acid.

7. *Platinum Foil*, polished and cleansed by treatment with hot sulphuric acid, alkali, and water, acts upon the dry gaseous mixture like spongy platinum; far below red heat, it causes with great readiness, the formation of anhydrous sulphuric acid, without the slightest evident alteration at its surface. It does not act at the ordinary temperature.

M. Mahla has found on this occasion that a mixture of peroxide of iron and oxide of copper, prepared by precipitation, and calcined when heated in a jet of hydrogen, becomes red hot like spongy platinum, and remains incandescent.—*Liebig's Annalen, Feb.* 1852.

For the Journal of the Franklin Institute.

Pacific Mail Steamer Golden Gate.

This vessel is the fastest steamship in the Pacific, and I furnish you with her log for the round trip between Panama and San Francisco; it will be seen that where coal is from $25 to $40 per ton, very great speed cannot be *afforded.*

Length on deck,	265 feet.
Breadth of beam,	40 "
Whole depth of hold,	20 "
Depth of hold for tonnage,	22 "
Tonnage,	2030 tons.
Two Oscillating Engines.	
Diameter of cylinders,	7 feet 1 inch.
Length of stroke,	9 "
Diameter of paddle wheels,	31 "
Length of paddles,	12 "
Depth of paddles,	2 "
Four Iron Tubular Boilers.	
Whole amount of fire surface,	12052 square feet.
Whole amount of grate surface,	367 " "

I will mention here, that her cut-off valve is a double beat or balance valve, and it is used at the same time as a throttle, being connected by a rolling joint on a radius bar; the said bar being worked by a cam on the shaft. It is the same size as the steam valve, (15 inches,) and it will only raise three inches, which is sufficient to use all the steam we can make.

Since she has been on this coast there has not, at any time, been less than four different kinds of coal in her bunkers, and almost all of it of a very inferior quality; some of it having been exposed on the beach for eighteen months or two years; and at other times she has taken the refuse out of four or five different ships.

Annexed is the Steam Log from San Francisco to Panama, and back to San Francisco.

Date. 1852.	Hours of Steaming.	Steam. lbs.	Vacuum. in.	Cut-off. ft. in.	Throttle. in.	Revolutions. per day.	Revolutions. per hour.	Revolutions. per knot.	Distance. per day.	Distance. per hour.	Coal used. per day.	Coal used. per hour.	Coal used. per knot.	Coal used. Total. tons.	Per cent. of ashes.	Draft of water.	Dip of wheels.	Saturation in boilers.	Remarks.
From San Francisco to Panama.																			
Jan. 21	2	10	25	4 6	2½	1532	766	76½	20	10	9200	4600	460		23	15 5	10	13	Light winds and calms.
" 22	24	10½	25	4 6	2½	18416	768	74¾	246	10¼	105672	4403	430	524	23			13	
" 23	24	10½	25	4 6	2½	19023	792	76	250	10½	111112	4630	444	553	26			13	Fine weather, light breeze, smooth sea.
" 24	24	11	25	4 6	2½	19503	812	74⅜	261	10⅞	115282	4803	442	588	28			13	
" 25	24	11	25	4 6	2½	20234	844	73⅜	277	11½	126948	5290	458	636	36			13	
" 26	24	9	25	4 6	2½	20260	844	70½	287	12	137952	5831	480	697	38			13	
" 27	24	9	25	4 6	2½	20006	875	69	290	12¼	117368	1890	405	584	28			13	Light winds and calms all these days.
" 28	20	10½	25	4 6	2½	17672	883	71	249	12¼	90576	1528	364	453	23	13 0	4 6	13	
" 29	12	10	25	4 6	2	9065	824	59¾	252	12¾	75344	4432	495	377	16	13 7	5 0	13	Stopped at Acapulco 16 hours.
" 30	24	12	25	4 6	2½	20575	857	79¾	259	10¾	103850	4328	401	567	20			13	
" 31	24	11¾	25	4 6	2½	21065	878	89¾	235	10	114704	4779	488	573	20			13	
Feb. 1	24	11	25	4 6	2½	20995	873	81½	259	10¾	120632	5026	465	660	20			13	Strong breeze from eastward.
" 2	24	10½	25	4 6	2½	21460	894	77	280	11⅝	120088	5004	429	60	20			13	Rain squalls and calms.
" 3	16	10½	25	4 6	2	13184	824	70⅛	188	11¾	74664	4666	397	373	21	12 3	3 8	13	Strong breeze and tide against us.
Feb. 12	8	12	25	4 6	2½	6280	785	89¾	70	8¾	54536	6817	779	274	19	15 1	7 4	13	Light wind, sail set running down bay.
" 13	24	11½	25	4 6	2½	18215	759	85½	213	8⅞	130532	5438	614	654	19			13	90 miles.
" 14	24	11⅝	25	4 6	2½	18830	784	79⅛	238	10	122944	5122	516	615	20			13	Light head winds.
" 15	24	11⅜	25	4 6	2½	19020	792	79¾	274	11¼	116280	1845	425	581	19			13	
" 16	24	11	25	4 6	2	18725	780	74½	252	10½	128754	5364	511	643	21			13	Strong breeze and rough head sea.
" 17	24	10½	25	4 6	2½	19130	797	77¾	246	10¼	123646	5151	503	617	22			13	Moderate breezes and head sea.
" 18	13½	11	25	4 6	2	11367	844	74⅜	153	11¼	61855	4418	404	317	22			13	Fine weather and calms; stopped at
" 19	9	10½	25	4 6	2½	6391	710	66⅜	96	10¾	50874	5653	530	255	21			13	Acapulco 25½ hours.
" 20	24	11	25	4 6	2½	19680	820	77¾	254	10⅝	120640	5026	475	604	20			13	Fine weather and calms.
" 21	24	11¼	25	4 6	2½	20385	849	80¼	254	10⅝	123666	5152	487	613	20			13	
" 22	24	11¾	25	4 6	2½	20555	856	79¾	258	10¾	127424	5309	494	637	20			13	Strong breeze and head sea.
" 23	24	11¾	25	4 6	2½	20670	861	80⅛	258	10¾	115092	4795	444	574	20			13	
" 24	24	10⅜	25	4 6	2	20687	862	78⅜	264	11	113729	4738	431	569	20			13	Light head winds and fine weather.
" 25	24	11	25	4 6	1⅞	21238	885	80⅞	264	11	112342	4680	425	561	21			13	
" 26	17½	10	25	4 6	1½	15384	880	80⅛	192	11	78257	4475	408	394	21	12 0	0 3	13	Strong breeze and head sea.
From Panama to San Francisco.																			

For the Journal of the Franklin Institute.

List of the Engineer Corps of the U. S. Navy.

Chief Engineers.

Charles H. Haswell,
William P. Williamson,
William Sewell, Jr.,
William W. W. Wood,
Henry Hunt,
Daniel B. Martin,
Joshua Follansbee,
Benjamin F. Isherwood,
Jesse Gay,
Samuel Archbold,
George Sewell.

First Assistants.

Nailor C. Davis,
Wm. Everett,*
Wm. H. Shock,*
James W. King,*
Michael Quin,
Geo. F. Hebard,
Wm. K. Hall,
John P. Whipple,
Elbridge Lawton,
Henry Mason,
James G. Young,
John Alexander,
Jesse S. Rutherford,
Robert Danby,
Wm. Holland,
Benjamin F. Garvin,
E. A. Whipple,
Theodore Zeller,
Thomas Kilpatrick,
Henry H. Steward,

* Passed as Chief Engineers but not yet Commissioned.

Second Assistants.

Charles W. Geddes,
John W. Parks,
Nathaniel Patterson,
Robert H. Long,
Alban Stimers,
Thomas A. Stephens,
John Farm,
F. C. Dade,
Geo. T. W. Logan,
E. S. DeLuce,
Harman Newell,
Montgomery Fletcher,
George Gideon,
Edward Fithian,
Wm. C. Wheeler,
D. B. Macomb,
Eli Crosby,
Andrew Lawton,
Wm. H. King,
Richard C. Potts,
J. C. E. Lawrence,
J. M. Maury,
James M. Adams,
Simon B. Knox,
Amos Broadnix,
Wm. A Latimer,
Jackson R. Hatcher,
James M. Hobby,
Daniel T. Mapes,
James H. Warner,
Washington H. Nones,
William H. Rutherford,

Third Assistants.

Geo. W. Alexander,
Thomas A. Jackson,
T. A. Shock,
Wm. J. Lamdin,
Charles H. Loring,
William S. Stamm,
H. S. Barker,
S. H. Houston,
C. W. Lee,
S. E. McElroy,
G. F. Barton,
Oscar Davids,
Alexander Henderson,
T. B. C. Stump,
C. H. Mannson,
C. T. Parke,
Virginus Freeman,
George E. DeLuce,
S. D. Hibbert.
J. R. Pomeroy,
P. H. Taylor,
George Johnson,
M. Kellog,
J. C. Hull,
J. C. Mitchell,
Wm. Gorton,
H. Fauth,
E. Robie,
H. Haines,
H. C. Jewell,
Wm. B. Brooks,
Samuel C. Sherry,
L. Arnold,
L. A. Williamson,
H. W. Spooner,
G. E. Shock,
J. D. Mercer,
J. M. Freeman.

Chief Engineers,	11
First Assistants,	20
Second Assistants,	32
Third Assistants,	38
Total,	101

For the Journal of the Franklin Institute.

The Collins Steamships.

In a recent number of the *Journal*, I had occasion, in replying to an article by *Britannicus*, (published in the *London Builder*, Oct., 1851,) to deny that the engines, boilers, &c., of the Collins steamers were in any way designed by English Engineers, and that whatever merit they might have, it was our own. The attention of Mr. James Brown, President of the Collins Line, having been drawn to the article before alluded to, he

addressed a note to Messrs. Stillman, Allen & Co., of the Novelty Works, New York, on the subject, and received the following reply:—

"JAMES BROWN, ESQ.—Dear Sir: We enclose the piece cut from *Galignani's Messenger*. It is quoted from the *London Builder*, and it is strange, indeed, that misrepresentations so utterly without any foundation, should find a place in any journal of any respectability.

"The writer states, as '*from undoubted authority, and as regards some particulars from his own knowledge*,' that '*the contractors of the American Line obtained permission from the proprietors of the Cunard Line, to take mouldings or castings of every part, even to the minutest particular, of the engines constructed by Napier, of Glasgow, on board the largest of their vessels.*'

"It does not seem to have occurred to the author of this remarkable assertion, whether it was very probable that the proprietors of the Cunard Line would feel disposed to render any such aid to a rival company, nor does he explain by what mechanical process, the ignorant Yankees were able 'to take mouldings or castings of every part, even to the minutest details of engines' on board of a vessel.

"How utterly without foundation this assertion is, any may see, who will barely look at the two sets of engines; even a casual glance is enough to show their utter dissimilarity throughout, in plan, and in detail; not one piece of one is like one piece of the other; on this point, the engines speak for themselves. They differ about as much as two sets of side lever engines can differ.

"But according to this writer, the possession of all the mouldings or castings was not enough, and, therefore, (he goes on to say,) 'in order that nothing might be wanting to make the engines equal to those in the Cunard steamers, the contractors imported men from the manufactories on the Clyde, for the purpose of making engines in New York.'

"A few facts will show the grossness of this misrepresentation, and exhibit the purely American character of the engines we built for your company.

"Of the proprietors of our concern, every one is a native of the United States, and acquired here whatever mechanical skill or knowledge he possesses.

"Of our foremen, every man (with one exception) was born in the United States, learned his trade in this country, and whatever they have done, in connexion with marine engines, has been at our works. The one exception referred to has been employed at our works for the last 19 years, and never did any work for marine engines in any other place.

"The draftsmen who made the drawings are our pupils, and acquired all the knowledge and experience they have in connexion with steam engines, in our drawing room. The men who superintended the setting of the engines are also natives of the United States, were once our apprentices, and acquired at our works whatever skill and experience they have.

"No man was ever imported from the manufactories of the Clyde, or from any other quarter, with reference to these engines, and neither in the preparation of the plans, nor in the construction of the work, did we ever receive any assistance, direct or indirect, from any engineer on the banks of the Clyde, or from any other part of Great Britain.

"In short, the engines were made of American iron, forged, or melted with American coal; they were planned by American heads, and put together by American hands. In plan, and many important features, they differ, not merely from the Cunard engines, but also from any ever built on the other side of the Atlantic, and we are happy to find that their excellence is so far acknowledged, as to render our English friends anxious to claim the credit of having produced them. Respectfully, yours,

STILLMAN, ALLEN & Co.

"*Novelty Iron Works, New York, Dec.* 23, 1851."

On an Improved Boiler for Marine Engines. By MR. ANDREW LAMB, of Southampton.*

The Peninsular and Oriental steamship *Ripon* is an iron vessel, of 1650 tons burthen, and has two oscillating engines, of 450 nominal horse power. She was built by Messrs. Wigram, in 1846, and was supplied with her machinery by Miller, Ravenhill & Co., of London, since which time she has been almost constantly running for the conveyance of the Indian Mail from Southampton to Alexandria.

Her average speed for the whole of this time has been 9·1 knots per hour. The boilers fitted to her by Messrs. Miller were of the ordinary tubular construction. They were in six pieces, had twelve furnaces, and 744 iron tubes, 3¼ inches outside diameter, 6 feet 6 inches long. The total fire-bar surface was 212 square feet, and the heating surface in tubes 3798 square feet, reckoning the whole of the inside surface of the tubes as effective.

The sectional area through tubes equals 36½ square feet; ditto through ferules, 28 square feet. These boilers were loaded to 10 lbs. on the square inch, but in consequence of being deficient in steam, the actual pressure attained at sea very seldom exceeded 4 to 6 lbs. when full steam was admitted to the cylinders; of course, the engineers found it to their advantage to keep it up to its full pressure by working the expansion apparatus. This deficiency of steam was found to be an increasing evil, the cause for which may be satisfactorily explained by a little consideration of the *modus operandi* of the sea-going tubular boiler. When commencing running with the boilers new, for a short period, dependent on the species of coal consumed, the tubular boiler offers its greatest advantage, and is, in fact, when properly constructed, as good an apparatus for evaporating water as can be imagined applicable to marine purposes. The tubes give an immense amount of heating surface, and in small compass, and from their form are capable of resisting great pressure, but after three or four days' steaming, these advantages diminish. The tubes have an accumulation of soot and light ashes inside them, which, by reducing their sectional area, sometimes from 50 to 75 per cent., diminishes the draft through the furnaces in the same proportion, and also reduces the effective heating surface to the same serious extent. This accumulation depends in quantity very much upon the coal. On one occasion the author was present in a vessel with tubular boilers, burning Scotch coal,

* From the London Artizan, March, 1852.

and they actually came to a dead stand, after only sixty hours' steaming, the tubes being nearly choked up, and requiring to be swept. When tubular boilers have made a few voyages at sea, the outside of the tubes becomes encrusted with saline matter, which gradually accumulates upon them, chiefly upon their bottom sides, and which hitherto it has been found impossible to remove by any other means than scaling them mechanically. The situation of the tubes (row over row) prevents this being accomplished, excepting upon the upper tiers, and the consequences are, that the tubes become coated with a crust $\frac{1}{4}$ or $\frac{3}{8}$ths of an inch thick, and the tube-plates also, which from its non-conducting nature greatly retards the transmission of the heat through it, and the tube plates becoming hot, crack and blister, and deteriorate very rapidly.

For the boiler to be described in the present paper, invented and patented by the author in conjunction with Mr. Summers, the following advantages are claimed over its tubular competitor:—

1st, That, while it possesses an equal amount of heating surface in the same space as tubular boilers, it is free from the evil of choking with inside deposits of soot and ashes, because the flues being in one sheet for their whole depth, the deposit falls into the bottom of the flues, and is swept by the draft through into the up-take, and thence into the chimney.

The flues are flat rectangular chambers, 6 feet 9 inches long, and 3 feet 3 inches high, open at each end, where they are fixed to the boiler. There are seven of these flues to each fire grate; the smoke spaces are $1\frac{3}{4}$ inches wide, and the water spaces $2\frac{5}{8}$ inches. The sides of the flues are $\frac{1}{2}$-inch thick, and they are supported by stays, fixed inside the flues. From this circumstance of there being no stays or other projections in the water spaces, an important advantage is gained—that no nucleus is offered round which the scale can collect, and no impediment to interfere with the complete and rapid cleansing of the water spaces from scale by means of the ordinary scrapers.

In another arrangement of these boilers, adapted for large screw steamers, and also for war steamers, the flues are placed alongside the furnaces and at the same level, instead of over the furnaces, as in the engravings, which arrangement protects the boilers from shot, by keeping them below the water line.

In these improved boilers, the same amount of heating surface can be obtained in the same capacity of boiler as with tubes; the only difference is, that if the tubes are $\frac{3}{16}$ths of an inch thick, they will of course be rather lighter than $\frac{1}{2}$-inch plates; but this difference, as compared with the gross weight, is so small as to be unimportant. In the event of any accident to any of the flues, they may be taken out, separately or collectively, to be repaired or replaced with new ones; but from the facility with which they can be kept clean, they ought, as in the old-fashioned flue boilers, to wear out the shell; the length of time being remarkable that a *thin* plate will last, if kept clean, and never overheated.

The last boilers of this construction examined by the author were those of the *Tagus*, 280 horse power, and in those boilers, after six days' steaming, the deposit was only three inches deep in the bottom of each flue;

and the total depth of the flues being 3 feet 8 inches, it follows that she had only thus lost about 6 per cent. of sectional area.

2d, That the improved flues, from having no projection either of rivet heads or stays in the water spaces, offer no obstructions whatever to the scaling tool, and are as easily kept clean as any part of any boiler can possibly be, thereby entirely removing the evil of a loss of heat through non-conducting deposits, and very much increasing the durability of the boiler.

3d, That the water spaces between the flues being comparatively large, and the sides of the flues perfectly vertical, the circulation of water in the boiler must necessarily be much more perfect than amongst a number of tubes, (amounting sometimes to thousands,) where the water has to wend its way in and out in curved lines. This greater perfection of circulation, the author thinks, must add greatly to the effectiveness of the heating surface in the improved flues.

It must be here mentioned, that these advantages do not now rest upon theory only, and that they have been fully realized by experience.

The first boilers fitted with these flues were those in the *Pacha*, in October, 1849, similar to those shown in the engravings, and up to the time of her unfortunate loss, these boilers gave entire satisfaction. Then followed a small boat, in January, 1850, and the *Tagus*, in August, 1850, since which their success has been rapid, as a proof of which, numerous vessels of different companies are being and have been fitted with them. The *Tagus* has now the oldest of the boilers, and there is in no part of them any signs of deterioration whatever; in fact, they are in every way perfect. There has never been any leakage, and the consumption of fuel is less than with her former tubular boilers.

The improved boilers now fitted to the *Ripon* were manufactured by Messrs. Summers, Day, and Baldock, of Southampton, and are in four parts, the boilers being placed in the wings, two forward of the engines, and two aft; the stoke-holes are thus in midships.

The space occupied by these new boilers is the same as the old ones, the arrangement mentioned having economized as much room as the increased size of boilers required, so that the same quantity of coal is carried in the same space as before. The new boilers have 16 furnaces and 246 square feet of fire-bar surface; 112 flues, 3 feet 9 inches deep × 6 feet 3 inches long, being 5440 square feet of heating surface, reckoning the whole inside surface (as in tubes); the sectional area through the flues, deducting the stays, = 54 square feet.

This large sectional area can be diminished at pleasure by a grating damper, which is hung at the front end of the flues, and extends about 10 or 12 inches down them, and which is worked by handles placed outside the boiler, and between the hinges of the smoke-box doors. The engineer can thus regulate the intensity of his draft at pleasure, according to the variety of the coal in use, &c., &c.

The new boilers of the *Ripon* are loaded to 13 lbs. per square inch; the flues being strongly stayed inside, would of course resist a far higher pressure with perfect safety; in fact, if required, they might easily be sufficiently stayed to resist steam of any pressure.

The *Ripon*, at the same time that the boilers were altered, had her com-

mon radial paddle wheels replaced by feathering ones, which consequently added much to the speed of the vessel.

The best speed of the engines of the *Ripon*, with the old arrangement, was about 15 revolutions per minute, and that of the vessel about 10 knots per hour, when quite light.

On the trial at the measured mile, December, 1851, the vessel was drawing 16 feet 3 inches forward, and 16 feet 7 inches aft; she had all her coal (422 tons) on board, her water, and some cargo, and consequently was pretty deep loaded. The speed of the engines was 19½ revolutions per minute, and of the vessel 11·3 knots per hour. Had she been light, as in the former trial, she would have probably gone over 12 knots. It appears, therefore, that the improvement in speed may be fairly stated as two knots per hour. The cylinders of the engines are 76 inches diameter × 7 feet stroke. Their nominal horse power formerly, at 15 revolutions, would be 404, and at 19½ revolutions, 526 horse power; so that the new boilers have given 122 horse power more steam, of an increased pressure of 3 lbs. per square inch, than the old ones. As the *Ripon* is now making her first voyage with the new boilers, the author cannot speak with any certainty about her consumption, but will give some details of the Peninsular and Oriental steam ship, *Bentinck*, which has made one voyage to Alexandria and back, with these improved boilers and feathering wheels.

The *Bentinck* is a wooden vessel, built by Wilson, of Liverpool, in 1844, and has side lever engines, by Fawcett and Preston. She is 2020 tons burthen, and her engines are 520 nominal horse power; her original boilers were of the old flue construction, and were loaded to 6 lbs. per inch pressure; her average speed at sea was 9 knots per hour, and her engines about 14 revolutions per minute.

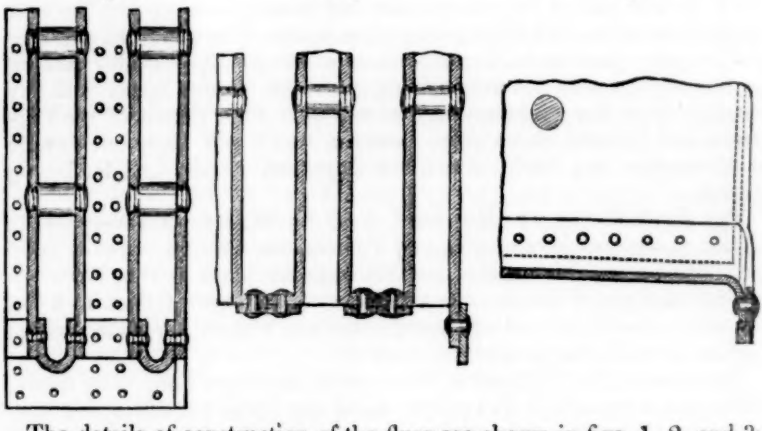
The speed of the *Bentinck* is now over 11 knots per hour. The former consumption was about 37 cwt. per hour; the present consumption averages about 38 cwt. per hour.

It must be noticed that the Peninsular and Oriental Company had tubular boilers, with brass tubes, made for this vessel by Messrs. Bury, Curtis, and Kennedy, and that they were brought to Southampton, and placed in the *Pottinger*, a sister ship of the *Ripon*, and of 450 nominal horse power, with common paddle wheels; these boilers are of exactly the same size as the patent boilers made for the *Bentinck*, and they are both loaded to the same pressure, viz: 12 lbs. per square inch; they have each made a passage to Alexandria and back, and, contrary to all expectation, the *Bentinck*, although her engines are 70 horse power nominal more than the *Pottinger*, and are working up to 103 horse power more, has consumed 128 tons less coal than the *Pottinger*, and performed the same distance in 68¼ hours less time. This result of diminished consumption is undeniably a fair triumph for the improved boiler; as for the improved speed of the vessel, it must share the honors with the feathering paddle wheel; the *Bentinck* has made the fastest passage on record between the ports mentioned.

In conclusion, the author can only say, that he believes the improved boiler, described in the present paper, will become the marine boiler generally adopted; as its merits are evident, and its cost is not greater

than tubular boilers; while its durability will, he thinks, be very much greater. He will be happy to show these boilers to any of the members of the institution who may have an opportunity of seeing those that may be in port; or at Mr. Summers' works at Southampton, where there are now five sets in course of construction. It may be added, that the screw steam ship *Glasgow*, by Messrs. Todd and McGregor, which has lately made the fastest run across the Atlantic of any screw steamer, is fitted with these improved boilers; Messrs. Todd and McGregor have made a considerable number of them, and they are also being manufactured by several others. It is intended also to adopt these boilers in the *Himalayah*, now building for the Peninsular and Oriental Company, of upwards of 3000 tons burthen, to be propelled by oscillating engines of 1200 horse power.

Fig. 1. Fig. 2. Fig. 3.



The details of construction of the flues are shown in figs. 1, 2, and 3; fig. 1 is a transverse section, fig. 2 a plan, and fig. 3 a longitudinal section of a portion of the flues shown on an enlarged scale. They are constructed of two flat side plates, $\frac{1}{4}$-inch thick, flanched outwards at each end, to meet the plates of the adjoining flues; the top and bottom of each flue is formed by the curved connecting piece, which is riveted to each side plate, and flanched outwards at the ends. The stays or studs are $1\frac{1}{8}$ inch diameter, and are riveted at each end through the side plates. The rivets connecting the plates together, and the stays, are all put into their holes simultaneously, and riveted cold by machinery. These rivets have countersunk heads and points, and when placed in their holes in the plates, a steel bar is inserted, which fills up the space between the heads of the two rows of rivets, and acts as a bolster to the riveting tool. By this means, one stroke of the machine closes two rivets at once, and in the most efficient manner. The flues are afterwards riveted together with covering strips, at their ends, and they are inserted into the boiler in sets of seven or eight, according to the size of the furnace.

Any one of the flues can be readily extracted from the others, if necessary, by cutting away the two rows of rivets at each end, and drawing it out through the front smoke-box doors. The experience which they have

had of the durability of the flues has, however, satisfied those who have employed them, that unless gross negligence of the engineer should (through want of water) allow them to get red hot, the flues will in all cases outlive the shells in which they are inserted. Drawings of the boilers will be found in the *Artizan* for December, 1850.—*Proc. Inst. Mech. Eng.*

The improved steam boiler of Lamb and Sumner has been secured by patent in this country, and is being used by the Navy Department on board the steamers *Princeton* and *Alleghany*.

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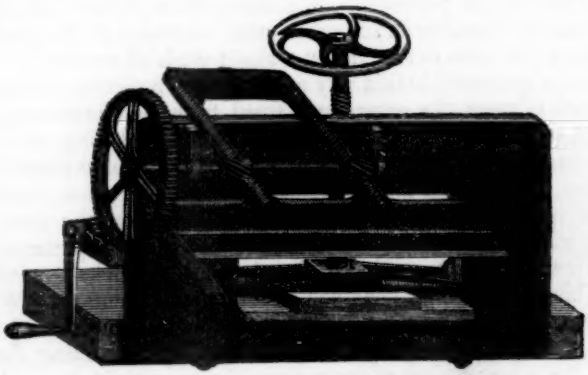
*Engraved Photographs—Bottier's Paper Cutting Machine—Colt's Revolver.**

It is now some time since we threw out an idea as to the prospective advantages of bringing the photographic process into more immediate connexion with the engraver's art, and pointed to the more than probable chance of fitting it for the part of the engraver's draftsman, in actually pencilling out the lines for the wood graver, the etching needle, or the burin. Considered in relation to engraving directly through the photographs themselves on copper plates, for the purpose of producing large plate engravings, such as are to be found interspersed throughout our own pages, we have, so far, seen no reason for a change of opinion upon the practical difficulties surrounding the project. We have, however, more especially contemplated its fitness for the smaller and otherwise more manageable work of the wood-engraver; and we can now point to the engraving which illustrates this article, as being a further illustration of the soundness of our earlier views.



[Engraved from a Collodion Film transferred to the wood.]

We may be wrong, and we are ready and willing to be set right if we are so, but we believe the annexed engraving of "M. Bottier's Paper Cutting Machine" to be the first published example of this branch of the economics of the atelier. We believe it to be the first engraving which

*From the London Practical Mechanic's Journal, May, 1852.

has been produced after the "pencillings of light." Our first theoretical notion, seeing the then apparent impossibility of engraving an actual daguerreotype plate, was to take the photographic picture on tissue paper, and lay this down on the plate or wood block, and engrave the design through it. Then we hit upon the plan of silverizing the wood block, placing it in the camera for the image, and finally engraving it direct. This project has not yet been realized, although the recent discovery of albumenized and collodionized glass has brought us within one stage of its accomplishment. At our suggestion, Mr. Urie, the artist to whom has been intrusted the execution of the whole of the wood engravings given in this *Journal*, turned his attention to these views of the subject. After long and careful experiments, he seized upon the collodion system as best suited for his purpose, and his success with it is best evidenced in the perspective figure of the machine to which we have already referred.

After obtaining the picture upon the collodion coating in the usual manner, he detaches the thin collodion film from its glass base, and lays it on the prepared wood block, just as we had previously proposed to do with the paper image. The engraver then engraves through the film, as if he were treating an actual drawing upon the wood surface.

It is obvious that the whole process, more especially the transfer of the pictorial film from its original foundation to the block, is a matter involving excessive nicety of manipulation. The operator proceeds by floating off the film in water, by placing the glass plate horizontally therein, and with the picture upwards, assisting the dislodgment of the film, when necessary, by slight mechanical action. Then, the wood block having its surface previously prepared with white of egg and lamp-black—the darkening being necessary to throw out the picture from its translucent ground—the film is carefully laid upon the block; the white of egg having sufficient adhesive power to hold it firmly down. At first, the very obvious difficulty of the peeling off, or disintegration of the film, opposed the efforts of the engraver in his subsequent treatment of the block; but the brittleness has been overcome by a slight wash of varnish.

Engravings produced in this way are light drawn pictures indeed. In his execution of them, the engraver is freed from the mannerisms or imperfections of the artist or mechanical draftsman, escaping, on the one hand, the dangers of the lack of "life," or the missing of expression; and, on the other, avoiding all inconvenience from chance, error, or neglect.

We are now more than ever inclined to think that the time is approaching when the engraver may produce his own "sun pictures" of all external views of existing objects, directly on his blocks—reducing or enlarging his scale with all imaginable facility and accuracy. What we have shown is a great step towards this end—of *its* powers of faithful rendering, our readers may satisfy themselves, by consulting *Le Genie Industriel*, for a comparison of our reduced figure, with M. Bottier's original drawing.

In the interval of writing and printing the present paper, Mr. Urie has succeeded in making daylight his "draftsman" on the wood. The little figure of Colt's "revolver," or "repeating pistol," given below, has been reduced directly on the wood, in the camera, from a larger sketch of Col.

Colt's. The history of the operator's course of procedure may be summed up in few words. He first tried a coating of ordinary printer's ink for the blackened coating of the wood, varnishing this over with white wax, which was finally covered with the collodion film. This was a failure, from the mingling of the collodion with the wax, and the camera produced an image which shortly left a mere white ground. The difficulty now was, how to procure a good intermediate varnish, and mastic, shellac, and copal, were all successively tried and laid aside. Then, in retracing the process, the printers' ink was discarded, and a mixture of lamp-black and white of egg substituted as the ground, with a naphtha solution of gutta percha as a varnish beneath the collodion.

But the best results have been obtained by drying on a coating of lampblack and white of egg, and varnishing this over with a coat of pure white of egg alone before laying on the collodion. The accompanying sketch of the pistol was so produced. After collodionizing the wood, it is dipped into nitrate of silver, and placed at once in the camera,

[Engraved from a Collodion Photograph taken directly on the wood.]

the picture being subsequently developed by dipping in sulphate of iron and nitric acid, washed in pure water, and finally fixed with hypo-sulphite of soda, just as in the process given by our correspondent, "H. R." at page 209 of our 4th volume. To preserve the picture, a final coat of mastic varnish is laid on.

Translated for the Journal of the Franklin Institute.

Note on the Crystals contained in Glass. By M. Leydolt, of Vienna.

I have been for some time employing myself in the crystallographic study of the silicates; and in this way have been led to submit them to the action of fluorhydric acid, for the purpose, especially, of distinguishing the constituent parts of the compound minerals, such as the agates. The crystallized quartz remaining untouched, forms prominences on the plane of the agate, so that after copying this design in relief, by means of galvano-plastic processes, we may take impressions, which are true etchings, and which give, with an exactness which the graver could never reach, all the so varied, and often so complicated interior conformation of the agates.

In proceeding in the same way with glass, I was astonished to see that glass is not a homogeneous substance, whatever may be its chemical composition; all the glasses which I have been able to procure, contain a

greater or less number of perfectly distinct, regular, and transparent crystals, which are imbedded in the amorphous material; to make them visible, it is only necessary to submit a slip of glass to the action of hydrofluoric acid gas, mixed with vapors of water. The operation is stopped the moment the crystals are uncovered by the dissolving of the surrounding amorphous part, which is generally more soluble than they, and the figures thus obtained, may be reproduced by the galvano-plastic processes.

The operation presents no difficulty; it is only necessary to place the slip of glass, on a certain inclination, in the mixture of sulphuric acid and fluor spar, which is used to produce the fluorhydric acid, so that one part of the slip may be plunged in the liquid, and the other be without it; the crystals then become visible above the line of separation, upon that face of the slip which is turned towards the liquid. These crystals also appear on the inner surface of bottles in which very weak fluorhydric acid has been kept, but they are then accompanied by broken lines and concentric circles analogous to those of agate.

These crystals may be followed in the different phases of their formation by means of the slags of smelting furnaces, and I have in this way been able to persuade myself that their number and their development depend essentially on the manner of annealing, and the greater or less rapidity of cooling of the mass.

There are also natural crystals perfectly formed, pure and transparent, which present the same defects of homogeneousness as glass, when they are submitted to the action of different solvents. This is a new subject of study with which I am at the present time employed.—*Comptes Rendus de l'Academie des Sciences*, (*Paris*,) *12th April*, 1852.

Translated for the Journal of the Franklin Institute.

Note on the Incrustations in Steam Boilers. By M. DELANDRE.

With well or spring waters, the evaporation produces the precipitation of the earthy salts, and gives rise to the incrustations which become so adherent to the wall of the boilers and the tubes that they cannot be detached. When nevertheless it is desirable to continue to use the boilers, a less quantity of steam is generated with a greater expense of fuel, and often the metal becomes softened in the parts where the incrustations are the thickest and nearest the fire, thus occasioning cracks and finally explosions.

To obviate the destruction and dangers in the use of steam, caused by the incrustations, the aggregation of the earthy and calcareous salts must be prevented, by making them soluble in place of insoluble as they were.

Now the protochloride of tin, under the influence of water, is converted into an insoluble basic subsalt, and a soluble acid salt, which dissolves the earthy salts.

After having undergone, for a long time, great annoyances in the use of tubular boilers, in spite of the use of known preservatives, I have for a year past obtained the perfect protection of these generators from incrustations, by placing 4 kilogrammes (8 lbs.) of protochloride of tin in a

boiler which works 12 hours every day, at a pressure of 3 atmospheres, and consumes in that space of time from 1500 to 1600 litres (400 galls.) of water, and is only emptied and refilled once a week.

For steam boilers which are emptied every day, and are of great power, the consumption of the protochloride of tin should be calculated at 1 kil. (2 lbs.) per cubic metre (35¼ cub. feet).

My tubes, stop cocks, and machines, which were also finally covered with incrustations, have been kept in the most perfect state of cleanliness.—*Comptes Rendus de l'Academie des Sciences*, (*de Paris*,) 29*th March*, 1852.

On a Continuous Expansion Steam Engine. By Mr. James Samuel, of London.*

The economy of working steam expansively is well known, but the application of the expansion principle is practicable only to a limited extent in most forms of engine, from practical difficulties in their mode of working, which prevent the attainment of the full economy of which the expansive principle is capable.

The greatest useful effect is obtained from the steam, when it is allowed to expand in the cylinder until its pressure upon the piston just balances all the useless resistances of the friction of the engine itself, and the resisting pressure on the back of the piston, (whether the pressure of the atmosphere, in a high pressure engine, or of the uncondensed vapor, in a condensing engine,) the surplus power beyond these useless resistances being alone available for the purposes to which the engine is applied.

But in driving machinery, so great a uniformity of motion is essential, that any great variation in the moving power throughout the stroke of the engine is inadmissible, as the fly-wheel would not be able to absorb enough of the excess of power to equalize the velocity sufficiently, by giving it out again at the deficient part of the stroke; consequently, though two engines are often employed working at right angles to each other, for the purpose of diminishing the variation in total moving power, the expansion principle can only be carried to a portion of the extent to which it is theoretically applicable.

Only in such engines as the large Cornish pumping engines can the expansion be carried practically to its full theoretical limit, as the variation in the velocity of the load moved is of much less importance in those engines, and the very unequal amounts of moving power that are developed in equal times, by the full carrying out of the expansive principle, which would produce the most prejudicial and inadmissible variations of velocity in the engine, are controlled within prescribed limits by the great weight of material to be moved by the engine in the pump rods and balancing machinery, forming, as it were, a distributing reservoir for the moving force developed.

In the locomotive engine there are practical difficulties in carrying out the expansion principle efficiently, beyond a moderate extent, in a single cylinder, from the shortness of stroke, and rapidity of reciprocation, and

* From the London Artizan, for March, 1852.

the construction of the valve motion; but the ultimate extent to which it could be carried would be limited by the maintenance of the blast, which requires that the jets of steam discharged from the cylinder into the blast pipe, should not be reduced below a certain pressure at the moment of discharge. Otherwise, the limit to which expansion might be carried would be the resistance of the atmosphere to the discharge of the steam, added to the friction of the engine, say above 10 lbs. per inch above the atmosphere.

The steam is cut off usually by the link motion at from one-third to two-thirds of the stroke, and the steam is consequently discharged into the blast-pipe at about from 30 to 60 lbs. pressure above the atmosphere, supposing it to be supplied to the cylinders at 100 lbs. per inch above the atmosphere.

It appears that the lower of these pressures is sufficient, or more than sufficient for the purposes of the blast, to maintain fully the evaporative power of the boiler under general circumstances, and that a portion of the steam discharged can be spared from the blast, to be subjected to a greater extent of expansion.

In the continuous expansion engine, the subject of the present paper, the steam from the boiler is supplied only to one cylinder; a portion of it is expanded into the second cylinder, which is of proportionately larger area, so as to equalize the total moving power of the two cylinders; and it is there further expanded down to the fullest useful extent, and then discharged into the atmosphere, the portion of steam remaining in the first cylinder being discharged as a blast at nearly the same pressure as the ordinary engines. The economy, therefore, consists in obtaining from such portion of the steam as can be spared from the blast, the additional power of expansion remaining in it, which is thrown away in the ordinary engine.

Fig. 1.

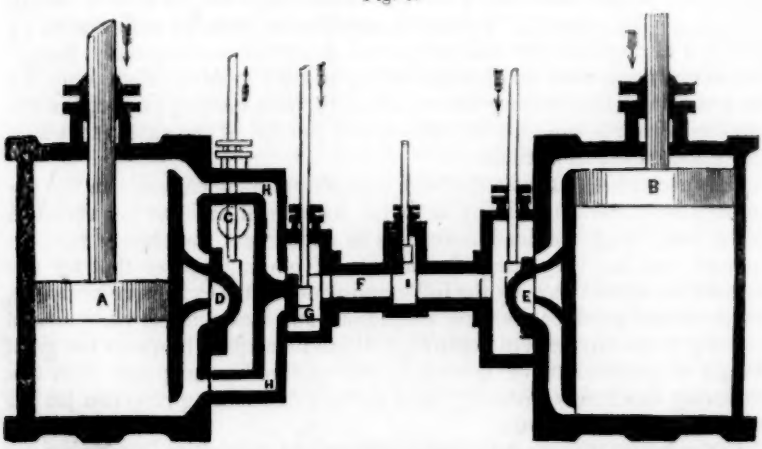


Fig. 1, shows the continuous expansion engine, as applied to a locomotive. A is the first cylinder into which the steam is admitted from the steam pipe, C, by the valve, D, in the same manner as in the ordinary

engines. The steam is cut off at half stroke, and a communication is then opened with a second cylinder, B, through the passages, H and F, by the opening of the slide valve, G. The second cylinder, B, is about double the area of the first cylinder, and the same length of stroke, but the cranks are set at right angles, as in ordinary locomotives; consequently, at the moment of the steam being passed into the second cylinder from the first, the piston of the second cylinder is at the commencement of its stroke.

The steam continues expanding in the two cylinders, until the first piston, A, has nearly completed its stroke, when the valve, G, shuts off the communication between the two cylinders, and the valve, D, opens the exhaust port, and communicates with the blast pipe, L, discharging the steam remaining in the cylinder, A, to form the blast in the ordinary manner. The second piston, B, has then arrived nearly at half stroke, and contains nearly one-half of the total quantity of steam originally admitted to the first cylinder; this steam is further expanded to the end of the stroke, and then discharged into the blast pipe, L, by the valve, E, opening the exhaust port.

The return stroke of both pistons is exactly similar to the foregoing, so that about a half cylinder full of high pressure steam (or such other portion as may be desired) is supplied to the first cylinder at each stroke, and between one-half and two-thirds of that steam is discharged at the pressure required to produce the blast, and the remainder of the steam is expanded down in the second cylinder, so as to give out all the available power remaining in it.

For the purpose of enabling the engine to exert an increased power, if required, at the time of starting a train or otherwise, the slide valve, I, is inserted in the centre passage, F, to close the communication between the two cylinders for a short time when required; and the steam from the boiler is then admitted by a pipe and cock into the steam chest of the second cylinder, B, which is then worked independently of the other cylinder, like an ordinary engine.

The comparative quantity of steam or of coke required to perform the same work in the several engines, under the circumstances stated above, is given by calculation as follows:

Continuous expansion engine,	100
Ordinary engine, cutting off at $\frac{1}{3}$rd stroke,	120
" " " $\frac{1}{2}$ stroke,	154
" " " $\frac{2}{3}$rds stroke,	185
" " " $\frac{7}{8}$ths stroke,	220

These figures represent the relative economy in the employment of the steam in the several engines; consequently, the ordinary engine, with the best degree of expansion, or cutting off the steam at one-third the stroke, consumes 20 per cent. more coke than the continuous expansion engine, to do the same work, and from 54 to 85 per cent. more coke with the more usual degrees of expansion; and an engine cutting off the steam at only one-eighth of the stroke from the termination, as many engines were formerly made, would consume 120 per cent. more coke to do the same work.

This plan has been tried upon two locomotives with satisfactory results, and the blast was found to be quite sufficient; but the trial has not been sufficiently complete to afford a definite comparison of consumption.

In the application of the expansion principle to stationary engines, it is requisite to consider the amount of variation in the moving power or laboring force of the engine, and the limits within which it is necessary practically to confine this variation. The accompanying diagrams show the variation in the moving power that takes place between the commencement and the end of the stroke in each of the several engines, all drawn to the same scale and on the same principle, so that the comparison of the diagrams will show the relative effect of the steam in the several engines; the same total power being represented in each case.

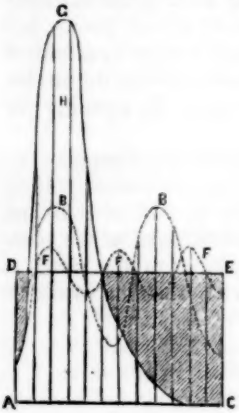


Fig. 3.

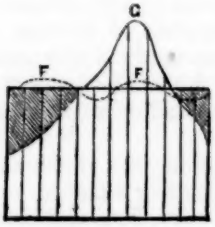


Fig. 4.

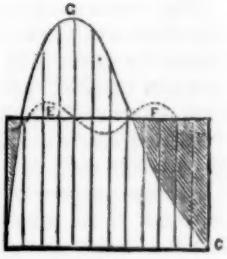


Fig. 5.

Fig. 3 shows the variation of power in the Cornish engine, when the steam is expanded down to the limit of useful effect; this is shown by the curved line, A G C. The vertical height of the first division, A D, represents the relative total moving force developed by the engine, in the direction of the revolution of the crank-pin, during the first 15° of revolution from the commencement of the stroke. The heights of the succeeding divisions in fig. 3 represent the corresponding amounts of force developed by the engine during each successive motion of the crank through equal angles of 15° each to the end of the stroke, C, and the half revolution of 180°; the force shown being in all cases the amount that would be produced in the circular direction of the revolution of the crank pin, not in the rectilinear direction of the piston. If the amounts of force in these several divisions were all exactly *equal to one another*, (and the engine, having attained its state of uniform velocity, were employed to overcome a constant resistance to circular motion, such as driving a corn mill or spinning mill, &c.,) then the crank arm would have a perfectly unvarying velocity, and no fly-wheel would be required. And the approach to this constancy of velocity, in any engine applied to overcome resistances to circular motion, will clearly depend on the approach to equality which these amounts of work produced through equal angles make to one another.

The average line, D E, shows this average equal height of all the several divisions; consequently the rectangle, A C E D, represents the equivalent uniform development of power that would produce an unvarying velocity of rotation, and therefore the area of the shaded space, being the deficiency in filling up this rectangle of uniform power by the actual working of the engine, (also equal to the portion H of the curved figure that is above the average line, D E,) will represent the total amount of variation from the average in the moving force of the engine throughout the stroke. The area of the shaded portion in this diagram is 43 per cent. of the total area, consequently the *total variation* from the average in the moving power of the Cornish engine is 43 *per cent.*, and the *greatest variation* at the extreme point G, amounts to 189 *per cent.* of the mean power.

The total variation from the average power, 43 pr. ct.
The extreme variation, 189 "

Fig. 4 shows in a corresponding manner the variation of moving power throughout the stroke in the continuous expansion engine, where the steam is cut off at half stroke in the first cylinder, and expanded in the larger cylinder down to the limit of useful effect.

The total variation from the average power is only 13 pr. ct.
The extreme variation, 55 "

Consequently the *total variation* in the moving power in the Cornish engine is $3\frac{1}{3}$ times as great as that in the continuous expansion engine, and the extreme variation is $3\frac{1}{2}$ times as great.

The dotted line, B B, in fig. 3, shows the effect of coupling together two Cornish engines, exactly similar to that shown by the full line in fig. 3, but of half the total power each.

The total variation from the average power is 20 pr. ct.
The extreme variation 58 "

The total variation in the moving power being $1\frac{1}{2}$ times as great as in the continuous expansion engine, and the extreme variation about equal. This arrangement would of course be much more expensive than the continuous expansion engine, as it involves two complete engines.

Fig. 5 shows the variation of moving power in a Woolf's double cylinder engine, where the pistons work simultaneously in the two cylinders, commencing each stroke together, and the steam is cut off at half stroke in the first cylinder, and afterwards expanded in the larger cylinder down to the limit of useful effect, as in the foregoing Cornish engine.

The total variation from the average power is 27 pr. ct.
The extreme variation, 90 "

Consequently the total variation in the moving power is 2 times as great as in the continuous expansion engine, and the extreme variation $1\frac{3}{4}$ times as great.

The dotted line, F F, on fig. 4, shows the effect of coupling together two of the continuous expansion engines at right angles to each other, and the result of this arrangement is a remarkably near approach to perfect uniformity of moving power.

The total variation from the average power is only 3 pr. ct.
The extreme variation, 8 "

The dotted line, F F, on fig. 3, shows in a similar manner the effect of

coupling together three of the Cornish engines, with cranks at 120° to each other.

The total variation from the average power is 9 pr. ct.
The extreme variation, 22 "

Both being about three times as great as in the continuous expansion engine.

Fig. 5 shows also by the dotted line, F F, the effect of coupling together two of the Woolf's engines at right angles to each other.

The total variation from the average power is 5 pr. ct.
The extreme variation, 13 "

Both being about 1½ times as great as in the continuous expansion engine.

The comparative amount of work performed by the several engines, with the same quantity of steam or of coal in each case, under the circumstances stated above, and taking the pressure of the steam admitted to the first cylinder at 50 lbs. per inch above the atmosphere, is given by calculation as follows:—

Continuous expansion engine, . .	100
Woolf's engine, ...	109
Cornish engine, ...	111

The general result of the above comparisons is, that the *Cornish engine is* 11 *per cent.*, and *Woolf's engine is* 9 *per cent. more economical* in expenditure of fuel than the *continuous expansion engine*, when the expansion of the steam is carried to the *extreme limit* in each case; but that this economy cannot be obtained practically in those two engines, on account of the great irregularity in their moving power, the *average irregularity* being, in the *Cornish engine* 30 *per cent.*, and in *Woolf's engine* 14 *per cent. greater* than in the continuous expansion engine; and the *extreme irregularity* being 134 *and* 35 *per cent.* respectively *greater.*

Consequently, it appears that, although the expansion of the steam cannot be theoretically carried to so great an extent in the continuous expansion engine as in the other engines, yet, from the moving power being so much more uniform throughout the stroke, the expansion can be carried *practically* to a considerably greater extent; and a greater amount of economy may be practically obtained within the same limit of uniformity in the moving power.

Hints on the Principles which should regulate the Forms of Boats and Ships; derived from original Experiments. By Mr. William Bland, *of Sittingbourne, Kent.**

Continued from page 49.

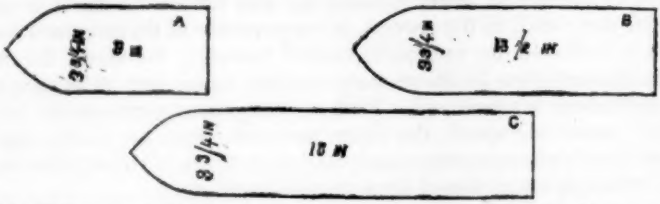
Chapter IX.—Of the Middle Length of a Ship.

The following experiments were undertaken to ascertain the properties of the middle length, or centre body of a ship. Three models having parallel sides, flat bottoms, the same form of bows, and all of the same breadth of beam, namely, 3¾ inches; yet varying in their lengths as fol-

* From the London Architect for September, 1851.

lows, but all of equal weight: length of A, 9 inches; B, 13½ inches; C, 18 inches.

Scale, ¼th inch to 1 inch. Weight of each 20 oz.



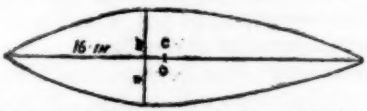
This difference in their respective lengths was made for the purpose of ascertaining the effects of increased length, with regard to speed, and the power of carrying weight.

Experiment 37.—The model, A, was tested by the balance rod, with B, and which beat in speed, A, so as to require the weight of 8 oz, to be put into B, to retard its speed to that of A.

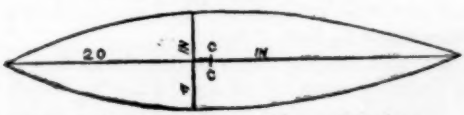
Experiment 38.—B, being tested with C, C required the weight of 8 oz. to be put into it, to cause the speed to equal B, being the same difference as in the first experiment; and, therefore, the speed of C will equal the speed of A, and carry at the same time, 16 oz. additional weight.

The same law exists in models of a different form, and is instanced in the following experiments. Three models were tested against each other to discover the difference in their speed, having level bottoms, of the same weight and breadth of beam, but varying in their lengths; scale, ⅕-th inch to 1 inch.

No. 1.—Weight, 22½ oz.; thickness, 2 inches.



No. 2.—Weight, 22½ oz.; thickness, 2 inches.



No. 3.—Weight, 22½ oz.; thickness, 2 inches.

Experiment 39.—No. 1 was so far inferior in speed to No. 2, that the extra weight of 12 oz. was put into No. 2 before its speed was retarded to the same rate of speed as No. 1.

Experiment 40.—Now, No. 3 beat in speed, No. 2, as to require 12 oz. to be placed in No. 3, to bring their speed to an equality.

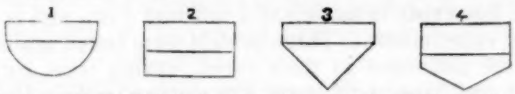
The inference to be drawn from the foregoing experiments is, that additional length gives increase of speed; or will carry the weight through

the water with proportional less resistance. The stability, likewise, increases with equal ratio, as given in experiment 7. The cause of this less resistance must arise, in the first instance, from the same dimensions of bows and breadth of beam clearing the way for the increased length of the after part; and, in the second, in consequence of the increased length, which is followed by increased surface bearing; therefore, the whole weight displaces less depth of water—hence arises less resistance when the length alone is concerned. With respect to the increase of the breadth of beam improving speed, the cause proceeds from the curves and the enlarged surface bearing combined; otherwise, the result of the experiments (Nos. 1 and 2, &c.,) would have decided contrary.

Chapter X.—Form of the Midship Section.

This chapter relates to the form of the midship section; its importance as to a ship's speed, and to determine which the experiments, as detailed in the subsequent pages, were resorted to.

Four models, all of the length of 14 inches, and 4 inches wide, having their sides parallel and bottoms level, of equal weight, namely, $30\frac{3}{4}$ oz., but the midship section of each varying as represented in the diagrams, were tested one with the other; first, to ascertain their speed; next, their stability; third, their lee way; lastly, their burden or floating depth.



Midship Sections; Scale, $\frac{1}{8}$-th inch to 1 inch. The dotted line is the float line.

The comparative velocities, as denoted by the balance rod, were as follows:

Experiment 41.—No. 1 beat in speed No. 2 by 2 oz., that extra weight being required in No. 1, to retard its speed till it equalled that of No. 2.

Experiment 42.—The speed of Nos. 2 and 3 proved equal.

Experiment 43.—The speed of No. 4 was the worst of them all, since it required 4 oz. extra weight to be put into No. 1, with which it was tested, before its speed equalled that of No. 4.

The inference to be drawn from the experiments is, that the curve gives greater speed than straight lines with angles. When the bottom of No. 4 had its angles cut off so as to form an ellipse, its speed was in consequence so far improved, that 2 oz. in No. 1 were sufficient; or the velocity of No. 4 became equal to Nos. 2 and 3.

Of the stability and floating depth of the above four models,—

No. 2. Stability equalled $3\frac{1}{2}$ oz. Floating depth $1\frac{1}{2}$ inch.
No. 4. Stability equalled 3 oz. Floating depth $1\frac{1}{4}$ inch.
No. 1. Stability equalled $2\frac{1}{4}$ oz. Floating depth $1\frac{3}{8}$ inch.
No. 3. Stability equalled $1\frac{3}{4}$ oz. Floating depth 2 inches.
No. 4. Ellipse equalled 3 oz. Floating depth $1\frac{1}{4}$ inch.

Here we have No. 2 possessing the greatest stability, and No. 3 the least, both being of the same speed. And again, No. 2 draws but 1 inch of water, whereas, No. 3 draws 2 inches, or double, though of equal weight.

(To be Continued.)

For the Journal of the Franklin Institute.

On the Telegraphic Lines of the World. By Dr. L. Turnbull.

Continued from page 45.

United States.

The following is a more correct list of the Telegraph Companies in the United States, obtained since the publication of my list in the July number of this *Journal:*—

New York and Boston Magnetic Telegraph Company, from N. York to Boston, about 250 miles; three wires, one passing through Providence, R. Island, the other through Springfield, Mass., using the Morse patent.

Merchant's Telegraph Company, from New York to Boston, about 250 miles; two wires passing through Providence, using Bain's patent.

House's Printing Telegraph, from N. York to Boston, 250 miles; one wire, uses House's patent.

Boston and Portland Telegraph Company, from Boston to Portland, 100 miles; one wire, using Morse's patent.

The Merchant's Telegraph Company have one wire from Boston to Portland, 100 miles; Bain's patent.

Maine Telegraph Company, from Portland to Calais, Maine, about 350 miles; one wire; Morse's patent.

St. Johns and Halifax line, from Calais to Halifax, about 400 miles; one wire; Morse's patent.

There is a line of Bain Telegraph from Boston through N. Hampshire to Burlington, Vt., thence to Ogdensburg, New York; about 350 miles; one wire.

New York, Albany, and Buffalo line, from N. York to Buffalo, through Albany and Troy; 513 miles long; three wires, using Morse's patent.

New York State Telegraph Company, from N. York to Buffalo, via Albany, two wires; 550 miles long, with a branch from Syracuse to Ogdensburgh, via Oswego; about 150 miles; one wire: also a branch from Troy to Saratoga, 36 miles; one wire; use Bain's patent. There is also a Morse line from Syracuse to Oswego, about 40 miles.

House Telegraph Company, from N. York to Buffalo, via Albany, 550 miles; two wires; use House's patent.

New York and Erie Telegraph, from New York to Dunkirk, via Newburgh, Binghamton, and Ithaca; 440 miles, one wire; Morse's patent.

New York and Erie Railroad Telegraph, for Railroad use, along the line of N. York and Erie Railroad, 460 miles; Morse's patent.

Magnetic Telegraph Company, from New York to Washington, via Philadelphia; seven wires, 260 miles; Morse's patent.

House Line from New York to Philadelphia, 100 miles, one wire; House's patent.

Troy and Canada Junction Telegraph Company, from Troy to Montreal, through Burlington, Vt., 260 miles; one wire; Morse's patent.

Erie and Michigan Telegraph Company, from Buffalo to Milwaukie, via Cleveland, Detroit, and Chicago; one wire all the way; second wire from Buffalo to Cleveland; 800 miles long; Morse's patent.

Cleveland and Cincinnati Telegraph Company, from Cleveland to Cincinnati; 250 miles long; two wires; Morse's patent.

Cincinnati to St. Louis, via Indianapolis, 400 miles long; one wire; Morse's patent.

Cleveland and Pittsburg Telegraph Company, from Cleveland to Pittsburg, 150 miles, one wire; Morse's patent.

Cleveland and Zanesville Line, from Cleveland to Zanesville, 150 miles; one wire; Morse's patent.

Lake Erie Telegraph Company, from Buffalo to Detroit, via Cleveland, 400 miles; one wire; Morse's instrument built under O'Reilly's contract with Morse, with branch from Cleveland to Pittsburg, 150 miles; one wire.

Cincinnati and Sandusky City Line, about 200 miles; one wire; Morse's patent.

Toledo to Terra Haute, via Forte Wayne, about 300 miles; one wire; Morse's patent.

Chicago to Dayton, one wire; Morse's line.

Chicago to St. Louis, via Peoria, about 400 miles; one wire; Morse's patent.

Milwaukie to Greenbay; 200 miles; one wire; Morse's patent.

Milwaukie to Galena, via Madison, about 250 miles; one wire; Morse's patent.

Chicago to Janesville; one wire; Morse's patent.

Buffalo and Canada Junction Telegraph Company, from Buffalo to Lamiston; one wire, connecting with a wire in Canada that runs to Toronto, about 200 miles.

Montreal Telegraph Company, from Toronto to Quebec, via Montreal, 600 miles; one wire; Morse's patent.

Montreal to By Town; one wire; Morse's line.

Having received later information in regard to some of the lines, I would make the following corrections to my article in the July number:

No. 2. "Atlantic and Ohio Telegraph Line" is so referred to as to convey the impression that it ran from Philadelphia to Milwaukie: this is not the case; the line belonging to that company runs from Philadelphia to Pittsburg. The Lake Erie Telegraph Company have a line from Buffalo to Detroit, with a branch from Cleveland to Pittsburg.

No. 4. The New York, Albany, and Buffalo Telegraph, extends from N. York to Buffalo, via Albany and Troy, 513 miles long, having eighteen stations between Buffalo and New York; connecting at Troy with Troy and Canada Junction Telegraph Company; at Syracuse with Syracuse and Oswego Telegraph Company; at Canandaigua with a line from Canandaigua to Jefferson, N. York; at Rochester with a line from Rochester to Dansville, N. York; at Buffalo with Buffalo and Canada Junction Telegraph Company, and with Erie and Michigan Telegraph Company; the latter extending from Buffalo to Milwaukie, via Cleveland, Detroit, and Chicago, 800 miles.

No. 6. There are three companies, if not four, owning the line from Boston to Halifax; from Boston to Portland there are two lines, one using the Morse instrument, and one the Bain instrument; from Portland to Calais,

Maine, one company, using the Morse instrument; from Calais to Halifax, the Morse instrument is used; the line in each province is owned by separate companies, organized under charters from their respective legislatures.

No. 7. The New York and Boston Morse line extends from New York to Boston; to reach Halifax it connects at Boston with lines in No. 6. "Also from N. York via Bridgeport to Birmingham, Connecticut, with eleven stations; there is no such line; there is a branch from New Haven to Waterbury, Conn.; there is no intermediate station.

"In April, 1852, direct communication was had between the N. Orleans Telegraph Office, and the Office of the New Orleans line, in Hanover St., N. York; the whole extent of near 3000 miles of wire having been successfully worked in one circuit."

The entire length of the line from New York to New Orleans, via Charleston, Savannah, and Mobile, is 1966 miles; and this distance was not worked in one circuit, nor can it be with either of the existing systems with the best mode of insulating in use. The instance of direct communication was secured by dividing the line into several circuits, probably five or six, and connecting those circuits through the agency of an instrument termed a connector, the effect of which is to cause one circuit to work the other through the entire series, thus producing a result similar to working through the entire line in one circuit. The connector is an instrument first invented and applied by E. Cornell, Esq., of N. York, on the N. York, Albany, and Buffalo line, at Auburn N. York, to work a branch line from Auburn to Ithaca, for the purpose of taking news reports at Ithaca; at the same time the wire being transmitted from N. York to Buffalo on the main line; this was adopted in the year 1846; it was found to work admirably, and he afterwards modified it so as to make it applicable to working both ways in a main line, or in other words, to make it capable of working a number of series of circuits in a main line; the instrument was adopted for this purpose on the N. York and Erie, and Erie and Michigan lines, in the year 1849, and has been in constant use ever since; by it they having frequently worked direct from N. York to Milwaukie, 1300 miles. The instrument used on the New Orleans line, which was described in my Lectures on the Telegraph, was adopted by Mr. Chas. Bulkley, the then superintendant of the line, who claims it as his invention, made in 1850 or 1851.

The greatest distance that Mr. Cornell has known any lines to work in *one* circuit, was from Boston to Montreal, via N. York, Buffalo and Toronto, a distance of about 1500 miles; this, however, was done when the earth was frozen, and the lines thus insulated by the frost much better than man has yet contrived to insulate them without its aid. There are no lines working succesfully in *one* circuit more than 550 miles; lines may be so insulated as to work in one circuit under states of the atmosphere from 8 to 1000 miles.

"The Atlantic and Pacific range, under the arrangement of Henry O'Reilly, Esq.; using a modification of Bain's Chemical Telegraph and Morse's instrument, from N. York to Washington, and N. York to Boston,

&c., &c." Mr. O'Reilly has nothing to do with either of those lines; he was contractor for building one of them, but has no interest in them, and no control over them. The lines in the west are owned by separate independent companies, over which he has no control. The line from St. Louis to Fort Leavenworth, O'Reilly has nothing to do with; it has been built by other parties in direct opposition to all of O'Reilly's movements.

The Bain Lines in the United States are as follows: "One from New York to Boston, two wires; one from N. York to Buffalo, two wires.

In the list of lines, there are No. 2, from Washington to New York, via Baltimore and Philadelphia, 5 wires, 250 miles each, 1250 miles; at No. 8, Philadelphia to New York, 6 lines, 120 miles each, 720 miles." Those are the same lines each, and they have been duplicated. Including the Bain and House lines, there are only 8 wires between New York and Philadelphia; the 9th one is now being put up by the Magnetic Telegraph Company.

No. 15. Bridgeport and Birmington line has not been in use for two years; is taken down.

No. 22. Troy to Whitehall, via Salem, not been at work for more than a year.

No. 25. Auburn to Elmira, via Ithaca, taken down more than a year ago.

No. 26. Binghamton to Ithaca, via Owego, is a part of the N. York and Erie line mentioned at No. 14, from New York to Fredonia.

No. 31. Cleveland to Pittsburg, via Alton, Illinois; this is an error, as Pittsburg is in Pennsylvania, east of Cleveland, and Alton is in Illinois, west of Cleveland more than 500 miles.

No. 33. *No such line as* from Pittsburg to Columbus, 680 miles; No. 34. No such line as this; there is a line from Columbus, Ohio, to Portsmouth, Ohio, about 100 miles.

No. 37. Columbia to Chilicothe is the same line as referred to above, No. 34.

There is not over 2200 miles of House wire up. "The 6000 miles of O'Reilly lines" are, to a great extent, embraced in the 17,283 Morse lines, and also embraced in the 1092 miles of Bain's line.

There is an "Erie and Allegheny Telegraph Company," having a line from Dunkirk, N. York, via Warren, Pa., thence to New Castle, Pa., and thence to Pittsburg.

Consolidation of Telegraphs.—We learn from the Cincinnati papers, that all the leading Telegraph lines in the West, and South, and Northwest have been united in business interests. The N. Orleans and Ohio line, extending from N. Orleans to Pittsburg; the People's line from N. Orleans to Louisville; the two wires, Louisville, Cincinnati, and Pittsburg line, and the Western line from Wheeling and Pittsburg to Baltimore and Washington city, are all direct parties to the contract—securing these arrangements.

The union brings the Morse and O'Reilly offices in Cincinnati and all other cities on the lines named together. In Cincinnati the Morse lines are removed to the O'Reilly office, which will hereafter be known as the *National Telegraph Office.*

The lines connected directly by this union, connect also indirectly with wires extending over thousands of miles, and embracing within their

iron arms almost every city and large town in the United States. Perhaps there are no lines of equal extent in the world, or working together with equal harmony, as those radiating from the National Telegraph Office in Cincinnati. They are seventeen in number, and embrace in all *ten thousand eight hundred and twenty-four miles of wire.*

The following report of the Cincinnati and Louisville Telegraph Company for 1850 and 1851, exhibits great enterprise, and the value of the telegraph as a mercantile investment in America. It appears that during the preceding year, three dividends of three per cent. each had been paid, and one quarter's dividend retained for rebuilding the line. The whole sum expended for repairs up to June 1851, amounted to $10,405·94. With this sum, 83 miles of poles have been reset, 146 miles put in repair, and 156 miles renewed. The receipts during the year 1850, were as follows:

Receipts.		*Expenditures.*	
Louisville,	$22,060·08	Fuel, Gas-Light, Candles, &c.,	$ 642·42
Madison,	2,155·99	Rent of Offices, Bridges, &c.,	1,558·70
Laurenceburgh,	192·60	Stationery of all kinds,	1,253·61
Cincinnati,	18,470·97	Salaries,	18,115·39
Dayton,	2,727·55	Refunded for despatches failing	
Springfield,	631·37	delivery,	619·86
Columbus	3,403·49	Repairs of the Line,	7,663·30
Janesville,	1,628·36	Cost of Batteries,	734·25
Mt. Washington,	72·37	Miscellaneous	4,425·64
Wheeling,	2,525·71		
Steubenville,	878·08	Total,	35,013·67
Pittsburgh,	17,992·17		
Total,	73,278·72		

Recapitulation.

Total Receipts for 1850,		$73,270·72
Paid to connecting lines,	24,788·45	
Expenditures,	35,013·57	59,802·90
Total Residue,		13,476·72

Statistics of the year 1850: Number of words transmitted, 3,602,760; number of despatches recorded, 364,559. These are exclusive of free matter, necessarily large at all times. Average hours of labor, fourteen per day. The record of despatches for 1850, on the paper of the registering instrument, covers a length of 1704½ miles: number of hands employed, 58.

The Law of Telegraph in the U. States.—An Act Relating to the Commencement of Actions, &c., Relative to Penalties on Telegraphic Operators, &c.

SEC. 7. That from and after the passage of this act, it shall not be lawful for any person connected with any line of telegraph within this Commonwealth, whether as superintendent, operator, or in any other capacity whatever, to use, or cause to be used, or make known, or cause to be made known, the contents of any despatch of whatsoever nature, which may be sent or received over any line of telegraph in this Commonwealth, without the consent or direction of either the party sending or receiving the same—and all despatches which may be filed at any office in this Commonwealth, for transmission to any point, shall be so trans-

mitted without being made public, or their purport in any manner divulged at any intermediate point, on any pretence whatever, and in all respects the same inviolable secrecy, safe keeping, and conveyance, shall be maintained by the officers and agents employed upon the several telegraph lines of this Commonwealth, in relation to all despatches which may be sent or received, as is now enjoined by the laws of the United States in reference to the ordinary mail service: *Provided*, That nothing in this act contained, shall be so construed, as to prevent the publication at any point of any despatch of a public nature, which may be sent by any person or persons with a view to general publicity.

Sec. 8. That in case any person, superintendent, operator, or who may be in any other capacity connected with any telegraph line in this Commonwealth, shall use, or cause to be used, or make known, or cause to be made known, the contents of any despatch sent from or received at any office in this Commonwealth, or in anywise unlawfully expose another's business or secrets, or in anywise impair the value of any correspondence sent or received, such person being duly convicted thereof, shall, for every such offence, be subject to a fine of not less than one hundred dollars, or imprisonment not exceeding six months, or both, according to the circumstances and aggravation of the offence.

Approved April 14, 1851.

(To be Continued.)

Translated for the Journal of the Franklin Institute.

Note on Galvanic Silvering. By MM. E. Thomas and V. Dellisse.

The beautiful investigations of MM. de Ruolz and Elkington, have proved that it is not all the solutions of the salts of silver that give, by the aid of the battery, a constant and adherent layer of metallic silver: that this property is limited to certain special solutions, whose characters appeared to be thus defined:

1st, That the liquid conducts the electricity sufficiently:

2d, That under the influence of the electric current, nothing but silver is deposited.

3d, That the liquid does not attack the metal to be covered.

4th, That the liquid has an alkaline reaction. To these four conditions M. Bouilhet has just added a fifth, which, according to him, is indispensable; that is, that the liquid shall contain a double salt of silver, and a fixed alkali, which in separating, gives rise to the silvering.

There are but two series of solutions which answer these conditions:

1st, The solutions of silver in alkaline cyanides, which are the only ones which heretofore have given results which are constant, and in all respects satisfactory.

2d, The solutions of silver in the alkaline hyposulphite of soda and potassa, which give, indeed, indications of silvering, but shew such variations in the thickness and adhesion of the silver deposited, that notwithstanding their lower price, it has not been possible to substitute these hyposulphites for the alkaline cyanides.

The salts having ammonia for their base, several of which dissolve the oxide of silver easily and in great quantity, are not, according to M.

Elkington, fitted to give solutions capable of silvering. It is, nevertheless, upon this series of compounds that we directed our examinations.

And in the first place, we satisfied ourselves that no salt of ammonia, neutral or alkaline, holding the oxide of silver in solution in water, could deposit metallic silver in a constant and adherent layer; the ammonia coming to the negative pole to destroy the deposit which tends to form there, and attack the metal to be covered.

We had a commencement of success, by employing alcohol as a vehicle, and saturating it with nitrate of ammonia, to make the bath a conductor, then dissolving in it the double nitrate of silver and ammonia, as neutral as possible. But, although this bath gave a thick and adherent silvering, it was subject to too many opposing accidents. The too great alkalinity of the liquid, the lowering of the temperature, the presence of the least trace of chlorides, prevented us from obtaining good results, besides which, the expenditure of electricity had to be considerable, and the copper to receive the deposit of silver must be first covered with a pellicle of that metal by the operation of whitening.

We were then led to remark that the silvering depended essentially on the reducing property of the bath, and a great number of experiments showed us that although alkalinity was a necessary character in the usual baths, it was an absolute obstacle in the case of the employment of the ammoniacal salts; that far from the acidity of the bath being hurtful, it was indispensable in the same case, provided it was due to an acid greedy of oxygen, and not attacking copper strongly.

We will here remind, that we did not seek to determine the phenomena in silvering by the cyanides, but only the conditions under which it is possible to deposit metallic silver on copper, using solutions of salts of ammonia.

A sealed package deposited by us in the session of the 23d Feb., contains a series of experiments made on this subject, but as we do not yet ask for its opening, because it also contains other researches which we have not yet concluded, we will briefly retrace here our principal experiments:

1st, Whatever may be the solution of silver in a salt of ammonia upon which we operate, it cannot give a constant and adhesive coat of silver unless it contains a free acid, greedy of oxygen, such as the phosphorous, sulphurous, hypophosphorous, and hyposulphurous acids. Thus the neutral or alkaline sulphite of ammonia does not give good silvering; but it gives it immediately when it is made decidedly acid with an acid greedy of oxygen.

2d, All the acids greedy of oxygen do not succeed; this is the case with nitrous acid, probably because it has too much affinity for the metal to be covered.

3d, All the solutions of salts of ammonia capable of dissolving the oxide of silver do not succeed; the solution of silver must, besides, be stable: thus the acid sulphite of ammonia, at first silvers, but soon decomposes rapidly, under the action of the battery, and the silver is almost entirely precipitated from it. But if, to the solution of acid sulphite of ammonia, we add the hyposulphite of ammonia, it becomes capable of furnishing a more stable bath of silver and one which gives better results.

4th, The presence of a double salt of ammonia and silver is not sufficient in order that the bath may silver; in fact, the neutral solution of the double nitrate of ammonia and silver does not silver; it gives indications of good silvering, if we saturate it with sulphurous acid. The same is the case with the double sulphite, except the stability of the bath, and *à fortiori*, the same is the case with the double hyposulphite.

5th, The presence of a double salt of silver and any alkali, is not a necessary condition for the silvering by the bath; in fact, the sub-citrate of silver, as M. Regnault showed, prepared by passing hydrogen over the proto-citrate, (precipitated cold, so that no aconitic acid may be found,) gives a solution which silvers well, but which is decomposed during use, which property does not permit it to be employed. The nitrate of silver also gives at first a good silvering, but one upon which the affinity of the nitrous acid for copper, soon exercises an influence.

6th, It appears to us, that in the baths which we have tried, the salt of ammonia has no other utility than to keep the silver in solution, while the property of silvering is entirely due to the presence of a free acid, greedy of oxygen. In fact, this acid acts only by disguising the ammonia without attacking the copper, for if the bath is acidified by sulphuric acid, no silvering is produced. Nevertheless, it may be seen by shaking well cleaned copper turnings with dilute sulphuric acid, that the metal is not sensibly attacked, while the sulphurous acid in the same conditions, attacks it very sensibly.

7th, In the baths which we tried, a platina anode gives better results than one of silver. In fact, the silver anode, either in these baths or in those of cyanide, does not dissolve in proportion to the silver deposited at the kathode; besides, a notable proportion of the silver of the anode is attacked, and precipitated as a sub-salt. Only, in the cyanide baths, it is necessary to employ the soluble anode, to avoid the disengagement of hydrocyanic acid, whilst the disengagement of sulphurous or hyposulphurous acid presents no inconveniences.

8th, To get adherence, the cleaning of the pieces to be silvered must vary according to the reaction of the bath; cleaning by acids gives adherence only in acid baths; it, on the contrary, destroys the adherence in the alkaline baths; this is perhaps caused by the difference of the molecular states of the copper when cleaned by pumice and potassa, or by an acid bath.

In fine, the bath which gave us the best results is a mixture at 8° (Baumé) of bisulphite and acid hyposulphite of ammonia, in which has been dissolved the oxide of silver, or an insoluble salt of that base, such as the chloride for instance.

Several distinguished Savans, MM. Dumas, Payen, Peligot, Edm. Becquerel, have already done us the honor of being present at our experiments, and appeared to admit their reality.

This bath, which appears to obey conditions, altogether different from those which have been heretofore laid down, has, moreover, a decided advantage over the cyanide baths, inasmuch as it is altogether inoffensive to the health of those who are using it, a consideration which perhaps may have some value in the eyes of the Academy. The bath is moreover

practically economical, for the salts which compose it are of but little value, and as it conducts electricity very well, it requires much less than the alkaline baths.—*Comptes Rendus de l'Academie des Sciences*, (*Paris*,) *12th April*, 1852.

Translated for the Journal of the Franklin Institute.

A New Arrangement of the Voltaic Couple. Note of M. Fabre de la Grange, *presented by* M. Becquerd.

I have discovered a method of making the current of the voltaic pile, perfectly constant and invariable, even for weeks and months, of whatsoever metals the electrodes may be formed; whether they be put into action by separate liquids, as in the combination of Bunsen, or by a single liquid, as in the arrangement of Volta.

This continuousness of the electric action is obtained, as is that of the heat of a furnace provided below with a grate to let the cinders fall, and continually supplied with combustible from above.

The means which I employ is simple, and fulfils all the conditions which can render it applicable in practice. In place of increasing the expense, it diminishes it.

Let us look first at the arrangement of a single couple with a single liquid. Let there be a vessel having a hole pierced in the middle of its bottom; in this vessel, let there be a concentric diaphragm of sail-cloth, rising not so high as the edge of the vessel, and fixed by cement to the bottom. Within the diaphragm is a cylinder of very dense gas-coke, surrounded by small pieces of the same material, and around the diaphragm a cylinder of amalgamated zinc, and acidulated water, which is supplied drop by drop from above.

Let us now join the poles by a conducting wire, and let us see what passes in the inside of the apparatus. The acidulated water which continues to come drop by drop from above, will pass over the top of the cloth diaphragm upon the charcoal, which will be thus continually washed by the movement of the liquid, without, however, being soaked, so that the polarization will be suspended, and the bubbles of hydrogen will disengage themselves freely from the interstices of the grains; on the other hand, the lower layers of acidulated water will, from the effect of the pressure which they support, filter slowly through the cloth, which the upper and middle layers will not do in any perceptible degree. Now these lower layers are precisely those which contain the sulphate of zinc which is to be eliminated. The result is an electric current, which is entirely constant until the zinc has entirely disappeared, and is obtained without other care than that of supplying the reservoir.

The following is the method in which I unite a large number of couples: the stoneware cups which contain them, being three or four diameters in length, and consequently resembling tubes, are united and cemented into a bundle or block easily carried. The upper surface is horizontal, small gutters lead the acidulated water to each cup. With this disposition, by placing a second reservoir over the pile, and changing the nature and

height of the diaphragms, it is easy to employ a second liquid, which is dropped directly, and drop by drop on the carbon; as for instance, nitric acid. It is used advantageously very weak, and when it can no longer serve for the Bunsen battery, because it no longer absorbs hydrogen.

The liquids, as they come off from the cups, are collected, and may serve again until they are saturated.

On the Decolorizing Property of Charcoal and several other Bodies. By E. Filhol.*

It is generally stated that charcoal is the only simple body which possesses the property of absorbing coloring matter dissolved in a liquid; it further appears from the investigations of MM. Bussy and Payen, that decoloration by charcoal is a purely physical phenomenon.

Several compound bodies (alumina, sulphate of lead prepared by the moist way, hydrate of lead,) also partake of the property of decolorizing liquids; but it is generally considered by chemists that the action exerted by oxides on coloring matter in the preparation of lakes, is chemical, differing in this respect from that of charcoal; nevertheless, Berzelius was of opinion that the decoloration effected by the oxides and metallic salts resembled that produced by charcoal. My object has been to prove:—

1. That charcoal is not the only simple body possessing the property of decolorizing liquids; sulphur, arsenic, and iron, obtained by the reduction of the hydrated sesquioxide by hydrogen, are all possessed of decolorizing power.

2. That the number of compound bodies having an appreciable decolorizing power, are more numerous than has been thought, and that this power appears to depend much more on the state of division of these bodies than on their chemical properties.

3. That such bodies which easily appropriate one coloring matter may have but little tendency to do so with another; thus phosphate of lime from bones (artificially obtained) scarcely decolorizes the sulphindigotate of soda, whilst it exercises a more energetic influence on tincture of litmus than does animal charcoal.

3. That the decoloration, in the majority of cases, is a purely physical phenomenon; thus the same coloring matter is absorbed by metalloids, metals, acids, bases, salts, and organic substances. It is easy, moreover, by employing suitable solvents, to remove the coloring matter in an unaltered state from the body which had absorbed it.

I do not doubt but that these facts may prove useful in analytical chemistry and in some manufacturing processes.

The following results, which I have extracted from my memoir, will give some idea of the energy with which certain decolorizing matters act.

* From the London Chemical Gazette, April, 1852.

My observations were made with one of Collardeau's double lunette colorimeters:—

Decolorizing Power of different Substances, compared to that of purified Animal Charcoal, supposed equal to 100.

	Tincture of Litmus.	Sulphindigotate of Soda.
Charcoal,	100·00	100·00
Pure hydrate of iron,	128·90	1·97
Alumina,	116·00	9·91
Phosphate of lime,	109·00	1·97
Iron reduced by hydrogen,	95·33	100·00
Milk of sulphur,	26·67	0·00
Deutoxide of manganese, (native,)	88·90	13·80
Indigo,	80·00	13·50
Oxide of zinc,	80·00	6·55
Stannic acid,	70·40	0·00
Antimonic acid,	66·66	1·97
Chromate of lead,	70·40	2·92
Litharge,	66·66	3·85
Sulphuret of antimony, (native,)	59·25	0·00
Sulphate of lead,	50·00	13·80
Deutoxide of copper,	26·67	0·00
Protochloride of mercury,	22·22	0·00
Sulphate of baryta, (artificial,)	50·00	0·00
Sulphuret of lead, (artificial,)	130·00	16·67

Comptes Rendus, Feb. 16, 1852.

Ellis' Blooming Rolls.

Mr. Thomas Ellis, of the Tredegar Iron Works, Monmouthshire, is the inventor of a simple modification of the common machine for rolling blooms or piles of iron, which possesses some very important advantages over the old arrangement. The system on which it operates is, that the rolls are made to rotate first in one direction and then in the other, so as to roll the pile backwards and forwards in the direction of its length, thus forming both ends of the bloom alike.

Fig. 1. Fig. 2.

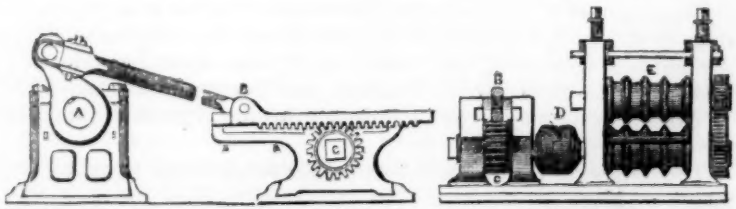


Fig. 1 is an end view of the rolls and actuating crank, the connecting rod of which is represented as broken away. Fig. 2 is a view at right angles to fig. 1, showing the rack and pinion apparatus as divested of the driving crank. The power is communicated by the main shaft, A, constantly revolving, and carrying on its end a powerful crank, to the pin of which is jointed a connecting rod, passing to an eye, B, on one end of a horizontal toothed rack. This rack slides in guides on the top of a pedestal, forming the bearing of a short shaft, having upon it a toothed pinion, C, with which the rack gears. This shaft is coupled at D with the lower of the pair of rolls, E, so that as the shaft, A, revolves, it gives a continuous reciprocatory rotary motion to the pinion, C, and through it to the rolls.